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The Engineer

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PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—
1. COPPER PLATES for LOCOMOTIVES.
2. ZINC TILES or SLABS.
3. STEEL WIRE, ANNEALED, GALVANISED and BLACK.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 25th August, 1922, for No. 1, and on Friday, the 1st September, 1922, for Nos. 2 and 3.

T. RYAN,
9033 Director-General.

India Office,
Whitehall, S.W. 1.

By Order of the Secretary of State for India in Council.
REQUIRED for service on Indian State Railways (North-Western Railway),
ONE ASSISTANT BRIDGE ENGINEER,
who will be required to work in the Technical Bridge Office or on Reconstruction of Bridges in the field.

Candidates must have had a good general and technical education and must possess the Associate Membership of the Institution of Civil Engineers or hold an exempting degree. They must have proved qualifications as Structural Engineers and be able to design large girders in all details. Preference will be given to applicants who have had experience of making investigations as regards strength and defects on old bridges, and especially in matters relating to secondary stresses, and of carrying out reconstruction schemes.

Age not to exceed 30 years, bachelor preferred.

TERMS.—A three years' engagement in the first instance, first-class free passage to India and home again on satisfactory termination of service at the end of the first three years.

SALARY.—On appointment (including technical pay and overseas pay) : Age 25, Rs. 525 ; 26, Rs. 575 ; 27, Rs. 625 ; 28 and 29, Rs. 675 ; 30, Rs. 725 ; rising by annual increments according to scale in force for approved service.

The selected candidate will be required to pass the Medical Board, India Office, before appointment.

Application may be made by letter only, and candidates must give full particulars of their general and technical education and of their practical training in the construction of girder work and erection of spans in the field. This information should be in chronological order, with dates. Age should be stated and details of war service (if any) given.—Letters of application, with COPIES ONLY of testimonials, should be sent to Messrs. RENDEL, PALMER and TRITTON, 12-14, Dartmouth-street, Westminster, London, S.W. 1, not later than 25th August, 1922.
9046

Royal Navy.
APPLICATIONS are INVITED for APPOINTMENTS as SCHOOLMASTER CANDIDATES.

Applicants must be between 21 and 30 years of age and medically fit.

They should have had Teaching Experience, or be qualified for Teaching Mathematics and Physics in Technical or Secondary Schools.

The following scale of pay has been approved :—

	A year.
Schoolmaster Candidate (for 6 months)..	£219
Probationary Schoolmaster (for 6 months)	£228
Schoolmaster (on confirmation, one year from entry)	£237

and thence by annual increments of £9 2s. 6d. a year to £456 a year.

Schoolmasters when confirmed have the rank of Warrant Officer, and are promoted to Commissioned Officer from Warrant Rank after 15 years' Service.

Special promotion to Senior Master is made by selection with minimum qualifying service of 8 years' Senior Masters are Commissioned Officers from Warrant Rank, and receive pay on the Schoolmasters' Scale, with an addition of £54 15s. a year.

Promotion to Headmaster, with rank of Lieutenant, is also by selection ; rate of pay from £511 to £657 a year.

One per cent. of the Schoolmaster Branch may also be promoted to the rank of Commander, with pay from £730 to £949 a year.

Further particulars may be obtained from the ADVISER ON EDUCATION, Admiralty, Whitehall, S.W. 1.
8962

Colombo Port Commission.
FOR SALE,
83-TON BLOCK SETTING TITAN,
Built by Messrs. Stothert and Pitt, Bath, England.

The machine is capable of lifting, lowering, racking in and out, slewing round the entire circle, and travelling with concrete blocks of 83 tons weight each, at a maximum radius, from the centre pivot of the machine, of 60ft. The Titan travels on 32 ground wheels running on two railways, the extreme rails of which are 25ft. apart, centre to centre ; each railway is 5ft. 6in. gauge between the rails.

The machine is capable of the several motions at the following speeds :—
(a) Lifting with full load, 8ft. per minute.
Lifting with light load, 20ft. per minute.
(b) Travelling with full load suspended, 50ft. per minute.
(c) Racking carriage with full load suspended, 20ft. per minute.
Racking carriage without load, 50ft. per minute.
(d) Slewing motion, one complete revolution with full load suspended, in 3 minutes.

All motions are performed by steam, except the lowering of loads, which is controlled by "Matthews" patent hydraulic brake.

All machinery and working parts are in good order.

A new steam boiler (vertical type) is required.

The steel structural work is generally in good order and has been regularly scaled and painted.

Further information may be obtained from the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, or from the HARBOUR ENGINEER, Colombo, Ceylon.
8924

PATENTS AND DESIGNS ACTS, 1907 AND 1910.

Notice is Hereby Given that VINCENT BENDIX, Manufacturer, of 1112, South Michigan-avenue, Chicago, Illinois, a citizen of the United States of America, SEEKS LEAVE to AMEND the SPECIFICATION (including the drawings) of LETTERS PATENT No. 120,138, granted to him for "Improvements in Engine Starters."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 2nd August, 1922.

Any person or persons may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C., within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
9021 Comptroller-General

PUBLIC NOTICES

Auckland Harbour Board, New ZEALAND.
TENDERS are INVITED for the SUPPLY and DELIVERY of :—
TWELVE (12) 5-Ton (and alternatively for 3-Ton) Semi-portal Balanced Jib ELECTRIC QUAY CRANES.
FOUR (4) 5-Ton (and alternatively for 3-Ton) Balanced Jib ELECTRIC ROOF CRANES.
SIX (6) 1-Ton ELECTRIC MONO-RAIL CRANES.

Specifications, diagrams and forms of Tender can be obtained at the office of the Board's Agents,
Messrs. W. and A. McArthur, Ltd.,
18/19, Silk-street,
Cripplegate, London, E.C. 2,
on payment of a deposit (returnable) of Two Guineas.

Tenders to reach Auckland by Noon on February 1st, 1923, addressed "The CHAIRMAN, Harbour Board, Auckland, New Zealand."
9006

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for the following :—
23 CARRIAGE and DINING CAR UNDERFRAMES, 5ft. 6in. gauge.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 10th August, 1922.

A fee of £1 1s. will be charged for the specification, which will not be returned.

Tenders must be submitted not later than Noon on Thursday, 24th August, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
T. R. WYNNE,
9048 Managing Director.

City of Birmingham Electric SUPPLY DEPARTMENT.
NECHELLS GENERATING STATION—
WORKSHOP EQUIPMENT.

TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION of POWER-DRIVEN LATHES, MACHINE TOOLS, LINE SHAFTING and PULLEYS at the Nechells Generating Station.

Copies of the general conditions, drawings, specification and form of Tender can be obtained on application to the undersigned, accompanied by a deposit of One Guinea, which will be refunded after the Tenders have been dealt with by the Electric Supply Committee, provided the contractor shall have sent in a bona fide Tender. The Committee does not bind itself to accept the lowest or any Tender.

Contractors must at the time of tendering, and at all times during the execution of the works, be paying their workpeople not less than the trade union or standard rate of wages in the districts where such workpeople are actually engaged in the execution of the works, and must be observing the recognised hours and conditions of labour.

Tenders, addressed to the City Electrical Engineer and endorsed "Tender for Machine Tools," must be delivered here on or before September 29th, 1922.

E. J. JENNINGS,
Secretary.
14, Dale-end, Birmingham,
5th August, 1922. 9037

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.
(Registered under the Trade Union Act.)
An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.
All communications to Head Office,
H. W. REID, 95, Belgrave-road,
General Secretary. Victoria, S.W.1
Ex

PUBLIC NOTICES

Borough of Reigate.
The Town Council of the said Borough invites TENDERS for the SUPPLY and LAYING of additional HIGH-PRESSURE CONCENTRIC and LOW-PRESSURE TWIN PAPER INSULATED CABLES.

General conditions, specifications and forms of Tender can be obtained from the Consulting Engineer, Mr. C. H. Wordingham, C.B.E., M. Inst. C.E., 7, Victoria-street, London, S.W. 1, and 11, Mosley-street, Manchester, upon payment of a deposit of Three Guineas (returnable on receipt of bona fide Tender). Extra copies One Guinea each, not returnable.

Sealed Tenders, endorsed "Tender for Mains," addressed to the undersigned at the Municipal Buildings, Reigate, must be delivered not later than 10 a.m. on Tuesday, the 22nd August instant.

The Council does not bind itself to accept the lowest or any Tender.

By Order,
ALFRED SMITH,
Town Clerk.
Municipal Buildings, Reigate,
5th August, 1922. 9028

Risbridge Union.
NEW BOILER, BOILER SETTING, BOILER-HOUSE, CHIMNEY SHAFT, &c.

The Guardians of the Risbridge Union invite TENDERS for ERECTION of BOILER-HOUSE, CHIMNEY SHAFT and BOILER SETTING, &c., at Kedington Institution, near Haverhill, in accordance with plan and specifications prepared by their Architect, Mr. H. B. Thake, of Haverhill, at whose office the plan and specifications can be seen or copies will be supplied by him on payment of the sum of £1 1s., which will be returned on receipt of a bona fide Tender.

The Guardians also invite TENDERS for a NEW CORNISH BOILER, 20ft. long by 6ft. diameter, as per specifications prepared by the Vulcan Boiler and General Insurance Co., Ltd., of 67, King-street, Manchester. Copies of such specifications can be obtained on application to the undersigned.

Sealed Tenders must be sent to me at my office, marked "Tender for Boiler Works or Boiler," as the case may be, so as to reach me not later than the second post, Tuesday, August 29th, 1922.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
S. L. BIGMORE,
Clerk.
Office : 3, Wratting-road,
Haverhill, West Suffolk. 9038

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—
1. STEEL BOILER PLATES.
2. STEEL AXLES for Locos., Carriages and Wagons.
3. STEEL BOILER TUBES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Steel Boiler Plates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 1st September, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the Specifications Nos. 1, 2 and 3.

Copies of the drawings may be obtained at the offices of Messrs. R. White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1,
11th August, 1922. 9049

PUBLIC NOTICES

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.
CHANCE PROFESSOR : F. W. BURSTALL, M.Sc., M.A. (Cantab), M. Inst. C.E., M. Inst. M.E.
LECTURER : E. C. PORTER, M.Sc. (Vict.), A.M. Inst. C.E.
DEMONSTRATOR : S. J. ELLIS, A.M.I.C.E.
LECTURER ON MACHINE DESIGN : F. H. BODEN.
ASSISTANT LECTURER ON MACHINE DESIGN : HENRY BAKER, B.Sc.

II.—CIVIL ENGINEERING.
BEALE PROFESSOR : FREDERICK C. LEA, M.Sc., D.Sc. (Lond.), A.M.I.C.E., A.R.C.S.
LECTURERS : E. C. PANTON, M.Sc. ; H. W. COULTAS, B.Sc. ; (Vacant).
LECTURER ON TOWN PLANNING : W. HAYWOOD.

III.—ELECTRICAL ENGINEERING.
PROFESSOR : WILLIAM CRAMP, D.Sc.
LECTURER : E. J. KIPPS, M.Sc., M. Inst. E.E.
ASSISTANT LECTURERS AND DEMONSTRATORS : O. R. RANDALL, B.Sc. ; H. VICKERS, M. Eng. ; G. M. HARVEY, B. Eng.

The FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after matriculation and pass successfully the Examinations at the end of each year will be ENTITLED to the DEGREE of BACHELOR of SCIENCE in Engineering.

THE SESSION 1922-23 COMMENCES ON OCTOBER 2nd, 1922.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR.
8899

University of Liverpool.
FACULTY OF ENGINEERING.

DEAN : Professor T. B. ABELL, O.B.E., M. Eng., E.C.N.C. (Ret.), M. Inst. N.A.

PROFESSORS AND LECTURERS.

ENGINEERING.
Harrison Professor—W. H. WATKINSON, M. Eng., M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Robert Rankin Professor of Engineering (Thermodynamics of Heat Engines)—G. E. SCHOLES, M.B.E., M.Sc., A.M.I.A.E.
John William Hughes Professor of Engineering (Strength of Materials)—W. MASON, D.Sc., M. Inst. C.E., A.M.I. Mech. E.

MARINE ENGINEERING.
Professors and Lecturers in Naval Architecture and Engineering.

ELECTRICAL ENGINEERING.
David Jardine Professor—E. W. MARCHANT, D.Sc., M.I.E.E.
Lecturer in Electrical Machinery—F. J. TRAGO, M.Sc., M.I.E.E.
Lecturer in Municipal Electrical Engineering—Vacant.

CIVIL ENGINEERING.
Professor S. W. PERROTT, M.A.I., M. Inst. C.E.
Lecturer in Railway Engineering—Associate Professor Sir J. A. F. ASPINALL, M. Eng., Past Pres. Inst. C.E., M.I. Mech. E., M.I. and S.I.
Lecturer in Municipal Engineering—Associate Professor J. A. BRODIE, M. Eng., Past Pres. Inst. C.E., M.I. Mech. E.
Lecturer in Dock and Harbour Engineering—Associate Professor T. E. WILTON, M.A., M. Inst. C.E., M. Cons. E.

NAVAL ARCHITECTURE.
Alexander Elder Professor—T. B. ABELL, O.B.E., M. Eng., E.C.N.C. (Ret.), M. Inst. N.A.

ENGINEERING DESIGN AND DRAWING.
Professor J. WEMYSS ANDERSON, M. Eng., M. Inst. C.E., M.I. Mech. E.

REFRIGERATION.
John William Hughes Professor of Engineering—J. WEMYSS ANDERSON, M. Eng., M. Inst. C.E., M.I. Mech. E.

METALLURGY.
Henry Bell Wortley Professor—C. O. BANNISTER, Assoc. R.S.M., F.I.C.

MATHEMATICS.
Professor F. S. CAREY, M.A.

APPLIED MATHEMATICS.
Professor J. PROUDMAN, M.A., D.Sc.

MATHEMATICAL HYDROGRAPHY.
Lecturer—E. O. STREET, M.A., M.Sc.

PHYSICS.
Lyon Jones Professor—L. R. WILBERFORCE, M.A.
Senior Lecturer—J. RICE, M.A.

CHEMISTRY.
Grant Professor of Inorganic Chemistry—E. C. C. BALY, C.B.E., M.Sc., F.R.S.
Senior Lecturer in Analytical Chemistry—J. SMEATH THOMAS, D.Sc.

GEOLOGY.
George Herdman Professor—P. G. H. BOSWELL, O.B.E., D.Sc., M. Inst. M.M., F.G.S.

The Prospectus of the Faculty may be obtained on application to the undersigned.

EDWARD CAREY,
8712 Registrar.

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PUBLIC NOTICES

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 23rd August instant, TENDERS for the SUPPLY of :—

(1) MATERIALS for STEEL FOUNDRY (Aluminium, Ferro-silicon, Canister and Fluor Spar).

(2) SPRING STEEL.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.

73-76, King William-street,
London, E.C. 4.
10th August, 1922. 9064

State Electricity Commission

OF VICTORIA.

FEED-WATER EVAPORATORS.—SPECIFICATION No. 227.

Prospective tenderers for the above plant are hereby notified that the DATE for the RECEIPT of TENDERS by the Commission in Melbourne has been EXTENDED from September 1st until OCTOBER 2nd, 1922. Copies of the specification, Tender form, &c., may be obtained from the Agent-General for Victoria, Melbourne-place, Strand, London, W.C. 2. Charges £2 2s. for the first two copies and 10s. 6d. per copy thereafter.

AGENT-GENERAL FOR VICTORIA.
Melbourne-place, Strand, London. 9032

State Electricity Commission

OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 229.—TRANSFORMERS, INDUCTION REGULATORS AND SWITCHGEAR.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £300 is to be lodged with the Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 4th November, 1922.

R. LIDDELOW, Secretary,
State Electricity Commission of Victoria,
Melbourne, Victoria,
9047 Australia.

Tyne Improvement Commission.

LOCOMOTIVE TANK ENGINE FOR THE COMMISSIONERS' NORTHUMBERLAND AND ALBERT EDWARD DOCKS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of ONE LOCOMOTIVE TANK ENGINE for their Northumberland and Albert Edward Docks.

Copies of the form of Tender, conditions of contract and specification may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Locomotive," must be addressed to the undersigned and delivered to him not later than Noon on Wednesday, the 30th day of August, 1922.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
J. McDONALD MANSON,
General Manager and Secretary.

Tyne Improvement Commission Offices,
Bewick-street,
Newcastle-upon-Tyne,
1st August, 1922. 9013

Tyne Improvement Commission.

BOILER FOR LOCOMOTIVE TANK ENGINE FOR THE COMMISSIONERS' ALBERT EDWARD DOCK, NORTH SHIELDS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of ONE BOILER for their LOCOMOTIVE TANK ENGINE No. 11 at the Albert Edward Dock, North Shields.

Copies of the form of Tender, conditions of contract, specification and drawing may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Locomotive Boiler," must be addressed to the undersigned and delivered to him not later than Noon on Wednesday, the 30th day of August, 1922.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
J. McDONALD MANSON,
General Manager and Secretary.

Tyne Improvement Commission Offices,
Bewick-street,
Newcastle-upon-Tyne,
1st August, 1922. 9014

Tyne Improvement Commission.

FOUR DIAMOND CROSSINGS FOR THE COMMISSIONERS' ALBERT EDWARD DOCK, NORTH SHIELDS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of FOUR DIAMOND CROSSINGS for their Railways at the Albert Edward Dock, North Shields.

Copies of the form of Tender, drawing and specification may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Diamond Crossings," must be addressed to the undersigned and delivered to him not later than Noon on Wednesday, the 30th day of August, 1922.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
J. McDONALD MANSON,
General Manager and Secretary.

Tyne Improvement Commission Offices,
Bewick-street,
Newcastle-upon-Tyne,
1st August, 1922. 9015

Calcutta Improvement Trust.

A TEMPORARY ASSISTANT ENGINEER is REQUIRED to SUPERVISE the CONSTRUCTION of a THREE-HINGED REINFORCED CONCRETE ARCH BRIDGE of 128ft. span in the North of Calcutta.

Candidates must have had several years' practical experience in the Construction of Arch Bridges or similar important works in Reinforced Concrete. Salary Rs. 1000/- (one thousand) per mensem, with a motor car allowance of Rs. 100/- (one hundred) per mensem, and a free passage to and from Calcutta. Appointment for two years, subject to six months' notice on either side. Applications will be received up to the 31st August, 1922, in England, by C. H. Bompas, Esq., C.S.I., I.C.S., Mayfield, Seaton, Devon, and in India by the Chief Engineer, Calcutta Improvement Trust, 5, Clive-street, Calcutta.

T. EMERSON,
Chairman.

Calcutta,
5th July, 1922. P5839

PUBLIC NOTICES

Cardiff Corporation Water-Works.

The Cardiff Corporation are prepared to receive APPLICATIONS for the APPOINTMENT of a JUNIOR ASSISTANT and DRAUGHTSMAN in the Waterworks Engineer's Office. Salary £216 per annum, rising to £350, less deduction of 5 per cent. for superannuation and 2½ per cent. on the 1st January next, and any general variations which the Corporation may make in future.

Preference will be given to candidates having experience in Waterworks Construction, and also to those who are students of the Institution of Civil Engineers.

Applications, in candidates' own handwriting, stating age, past and present employment, and accompanied by copies of not more than three recent testimonials, to be sent to me endorsed "Junior Assistant, Waterworks Engineer's Office," on or before Monday, the 21st inst.

Canvassing, directly or indirectly, will be a disqualification.

By Order,
CECIL G. BROWN,
Town Clerk.

City Hall, Cardiff.
4th August, 1922. 9024

SITUATIONS OPEN

WANTED, ENGINEER or CHEMIST, Having Electrical training with practical and theoretical knowledge of A.C. electrical instruments. Splendid opening for energetic, intelligent, technical man. State age, married or single, salary expected, and full details of education and experience.—" L., Box 10," care of Willing's, 33, Knightsbridge, London, S.W. 1. 9060 A

ASSISTANT to CHIEF ENGINEER for Maintenance of Plant in Central Africa; sound practical and theoretical experience and good education essential; able to handle men; knowledge of Oil Mill Machinery and control of stores; also some French desirable.—Write, giving full particulars of qualifications, experience, salary expected, and age, which should preferably not exceed 30-32, Box D401, Lee and Nightingale, Advt. Offices, L'pool. 9016 A

CHIEF ENGINEER, Under 40, REQUIRED for Large Ore Milling Plant in South America; knowledge of operation Steam Turbine Generators and Alternating-current Distribution System essential.—Particulars, experience, and copies testimonials, with salary required, to Box L141, c/o Jackson's, 19, Cullum-street, E.C. 3. 9043 A

ENGINEER.—WANTED by a London Engineering Concern, with works in the provinces, a competent ENGINEER, with first-class experience in the Design and Manufacture of all types of modern Condensing Plant. Applicants must possess first-rate technical ability, and be capable of carrying through new developments in design, and the initiation of the necessary experimental work. The vacancy offers scope to a man of real ability, and none but suitable men need apply. Full particulars of experience, qualifications, age and salary required.—Address, 8971, The Engineer Office. 8971 A

ENGINEER WANTED for Textile Factory in India. Must be fully qualified and technically trained to take charge of steam and electrical power plant consisting of reciprocating engines and turbo-alternators.

The engineer appointed will be responsible for the operation of the power plant as a whole, and must be experienced in engineering as applied to the textile industry.

Candidates to apply in the first instance by letter, stating age, whether married or single, qualifications and experience, also salary required, to 9026, The Engineer Office. 9026 A

ENGINEERING ASSISTANT WANTED, with Experience in both the Design and Construction of Reinforced Concrete Reservoirs. Salary £350 to £400 per annum.—Apply by letter before August 25th, stating age, qualifications and experience, with copies only of testimonials, to Mr. ALFRED R. E. BLACKBURN, M. Inst. C.E., Engineer and General Manager, Sunderland and South Shields Water Company, 29, John-street, Sunderland. 9025 A

FIRE and HYDRAULIC ENGINEER WANTED by City Firm; must be a capable draughtsman, experienced in design and installation of the various systems for protection from fire.—Address, stating age, qualifications, and salary required, 9022, The Engineer Office. 9023 A

LEADING CYCLE and MOTOR CYCLE COMPANY REQUIRES competent WORKS MANAGER, having thorough experience of all departments of cycle and motor cycle manufacture; design, organisation, production, control of staff. Financial interest acceptable, but not essential. Remunerative position for qualified man. Write in strict confidence, with all details.—Address, 9044, The Engineer Office. 9044 A

MECHANICAL ENGINEER WANTED, to Take Charge of all Machinery and Plant for a large Tin-plate Mill in India. Applicants must have thorough knowledge of maintenance and repairs of heavy rolling mills, boilers, pumps, hydraulic machinery, &c., and the usual tin mill plant. Age 30 to 40 years. State fully technical training and experience, salary required, and send copies of recent testimonials. No candidate without a thorough experience of the above need apply.—Apply, TIN-PLATE ENGINEER, 796, Shaw and Blake, 8, Bell-yard, Temple Bar, W.C. 2. 9041 A

REQUIRED IMMEDIATELY by Firm in Belfast, SEVERAL thoroughly competent STRUCTURAL STEEL WORK DETAILERS.—Address, stating age, experience, and salary expected, 9017, The Engineer Office. 9017 A

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For continuation of Small Advertisements see page 3.

The Stability of the Sailing Warship

No. III.*

By A. W. JOHNS, C.B.E., R.C.N.C., M.I.N.A.

WITH the accession of James I. interest in naval matters increased, and a new "great" ship, the Prince Royal, was designed and built by the famous Phineas Pett. Pett was the Junior Master Shipwright at the time. His choice for the designing and building of the vessel was resented by the two other Master Shipwrights, Baker and Bright, and led to an inquiry into the matter by the King. At this inquiry it was stated that at an early stage of his career Pett had rebuilt the Moon and Answer at Chatham and also built a merchantman, the Resistance. The three vessels on completion proved crank, and had to be sent back to Chatham for alteration. Baker, who made this statement, also pointed out that the Prince Royal's "depth is too great and her side too upright, so that of necessity she must be tender-sided and not able to bear sail," and also "her breadth lieth too high, and so she will draw too much water." The extreme breadth was 43½ft. and depth of hold 18ft., so that taking the latter to be equal to the draught of the body, the ratio of breadth to draught was a little over 2.4. This ratio was greater than that usual at the time, and shows that Pett had learnt something from his experience on the three ships first mentioned. The Prince Royal was rebuilt in 1641 and 1663, and although there do not appear to have been any complaints as to her stability she was broadened to 45½ft. on rebuilding. The Sovrayne of the Seas, the masterpiece of Pett, was built in 1635–7, the keel length being 127ft., the extreme breadth 48ft., and draught 19½ft. Deducting 1ft. for the projecting keel, these figures show a ratio of beam to draught of body of 2.6, a further improvement as compared with the Prince Royal. The Sovrayne's stability on completion was not, however, satisfactory, and she was "cut down a deck," by which is meant probably that one of the partial decks aft was removed. She was designed as far as upper works were concerned with the towering poop of the Elizabethan ships. The official records show that she was designed to mount ninety guns, but late in her construction Charles decided to increase the number to 102. This added 24 tons top-weight in guns alone. Rebuilt in 1660 and 1684, her breadth was increased to 50ft., but according to Pepys' list of ships her draught had considerably increased from the designed amount. She was burnt in 1696.

One notices in both the Prince Royal and Sovrayne a smaller ratio of length to breadth than was usual or as recommended by the 1618 Commission. In the first-named ship this ratio was 2.64, and in the Sovrayne 2.44, compared with 3 of the Commission. Possibly the latter only referred to two-decked ships, whilst both of Pett's ships were three-deckers, and a greater breadth was considered necessary by him.

The 1618 Commission also recommended that ships should be "somewhat snugg built without double galleries and too lofty upper works which overcharge many ships and make them coome faire but not work well at sea." The alteration made in the Sovrayne confirmed the wisdom of this recommendation. William Burrell, the only technical officer of the 1618 Commission, built the Victory in 1620, and presumably should have embodied the Commission's views in her design. She was rebuilt in 1665, and the breadth increased from 37½ft. to 40ft. Several other vessels built by Burrell were reported by a special Commission of 1623 as "tender-sided."

An interesting case of faulty stability was that of the Unicorn, built by Edward Boate in 1633. Her keel length was 107ft., breadth 36.4ft., and draught 16.3ft., and she was designed to carry 46 guns. Commissioned by Pennington in 1634, he reported her as unable to carry sail, but "in regard to the poor man's disgrace who built her," promised to proceed on trial. The first day's trial "found her so tender-sided that all the company affirmed she was not fit to go to sea, for she laid the ports of her lower tier under water." The second day 100 tons of ballast were shipped, which increased the draught 4in. to 6in. The third day "she stooped so much that we durst not open a port of our lower tier, for they were under water." These ports, designed to be 5ft. above water, were actually only 43in. Peter Pett recommended she should be girdled, and this was eventually done, although Trinity House, when appealed to, recommended she should be cut down a deck. The lowest tier of guns was taken out, and she became a 34-gun ship. Sir Henry Mainwaring—a Trinity House Master when the Unicorn's stability was considered—was her commanding officer in 1636, and reported "that being girdled only with 3in., 4in. and 5in. plank 7 strakes, she is now as stiff a ship to bear sail as any I think in the kingdom." This was in confirmation of a suggestion of the Earl of Northumberland, Lord High Admiral, who, in 1636, reported to Charles I., "The girdling of some of your Majesty's ships and taking away their galleries will add much to their force." Edward Boate, the builder of the Unicorn, built no other ship for the Navy.*

During the Commonwealth a large number of warships was built to provide for the wars with France, Spain and Holland. By comparison of dimensions, it is evident that the ratios of length to breadth and breadth to draught were increasing. The largest ship built was an 80-gun ship, the Naseby, afterwards the Royal Charles, captured at Chatham by the Dutch in 1667. Her keel length was 131ft., breadth 42ft., and ratio beam to draught nearly 2.5. Three 64-gun ships—the Fairfax, Dunbar and London—were also built, and it is curious to note the differences in the beams of the three. The Fairfax, with a breadth of 34½ft., had to be girdled and her beam increased to 36ft., with a reduction in the number of guns to 52. The beam of the Dunbar was 46ft., and ratio beam to draught nearly 2.7ft., whilst the London had a beam of 41ft., and a ratio of 2.6.

In 1665, Pepys reports another "great step and improvement in our Navy," in the completion of the Warspight and Defiance, designed by Sir Anthony Deane and built by contract. Deane himself built the Rupert, of the same class, which Pepys states was "the best ship ever was built." These ships carried their lowest guns 4½ft. above water when carrying six months' provisions and stores. The Warspight had a ratio of beam to draught of 2.3, and the Rupert a somewhat less value. These ships mounted seventy guns.

In 1673 the French fleet, then in alliance with England, visited Spithead and was inspected by Charles II., who, pleased with the appearance of the ships, ordered Sir Anthony Deane to build one as nearly as practicable on the lines of the Superbe. The result was the Harwich, a 70-gun ship, which proved on completion to be the finest sailing ship of the fleet. Several others were ordered to be built to her lines. Compared with the Rupert, she was 5ft. longer, 2½ft. wider, 6in. more draught, and of a tonnage of 990 compared with 830. The main difference was the increase in breadth, with consequent improvement of stability. The comparison shows that English ships were generally overgunned as compared with foreign ships, a criticism which was made by Raleigh early in the seventeenth century.

Pepys well understood the importance of breadth on a ship's stability, and referred to it in a speech before the House of Commons when explaining some naval proposals in February, 1677. In this speech he urged "our building ships more burdensome, stronger, and giving them more breadth," the advantages being that no girdlings would be required, and it would "make them bear sail better, our great ships being generally crank-sided.' It would also "make them carry their guns better—that is higher—our great ships failing therein." He gave dimensions and tonnages of French and Dutch ships in comparison with English, which clearly showed that the breadths of the former were greater, as also were the tonnages for the same number of guns carried. Possibly Pepy's insistence on the value of breadth was a result of the success of the Harwich, for in his Memoirs he writes: "The builders of England before 1673 had not well considered that breadth only will make a stiff ship," and goes on to state that many ships built previously had proved useless until they were girdled.

Curiously enough, Paul Hoste, the French Jesuit, in his book published in 1697, states that all the larger French ships were crank when launched, and had to be girdled. He asks why it is that the French constructors do not build their ships with the breadth finally given them after the addition of girdlings.

The Dutch warships, on the other hand, were generally satisfactory so far as stability was concerned. The shallowness of the Dutch waters necessitated a smaller draught and a corresponding increased breadth as compared with those adopted by other nations, and these two differences resulted in improved stability.

Possibly as a result of Pepy's remarks, a Commission in 1677 formulated a list of dimensions for ships carrying 100, 90 and 70 guns, which was followed in 1691 with similar information for ships of 80 and 60 guns. Establishments of dimensions were also promulgated in 1706, 1719 and 1745, and proposed in 1733 and 1741. In the case of the 1745 Establishment a letter was sent to the Master Shipwrights at the Royal dockyards requesting them to forward their proposed dimensions for the various rates. These figures were to allow for the lowest tier of guns being carried 6ft. above water when the ship had four months' provisions and stores for foreign service on board. The letter stated, "It is also a general complaint that the ships are crank, and heel so much in blowing weather that they cannot open their lee gun ports; at the same time as the ships of other nations go upright with all their batteries open and ready for action." The Master Shipwrights forwarded their proposals to the naval authorities, who probably compared the dimensions with those of the ships of other nations and finally made their recommendations. Presumably a similar procedure was adopted by the earlier Commissions.

It is instructive to compare the dimensions recommended at the various dates, and also with those of French ships built about 1677.

		Length on gun deck.	Length on keel.	Breadth.	Depth of hold.	Tonnage.
Ships of 90 Guns.						
1677	Establishment ..	158	—	44	18½	1307
1677	French	171	136½	44½	20½	1539
1706	Establishment ..	162	132	47	18½	1551
1719	Establishment ..	164	134	47½	18½	1566
1745	Establishment ..	176	142	49 1/12	21	1827
Ships of 80 Guns.						
1691	Establishment ..	156	—	41	17½	1100
1677	French	164	131	42½	19½	1357
1706	Establishment ..	156	127½	43½	17½	1233
1719	Establishment ..	158	—	44½	18½	1350
1745	Establishment ..	165	133	47½	20	1580
Ships of 60 Guns.						
1691	Establishment ..	144	—	37½	15½	900
1677	French	143½	114	37½	17½	892
1706	Establishment ..	144	119	38	15½	914
1719	Establishment ..	144	—	39½	16 5/12	951
1745	Establishment ..	154½	127	42⅔	18½	1297

The breadths of the French ships are to the outside of frames, i.e., they are the moulded breadths, and to them must be added 1ft. to 1½ft. to compare with the extreme breadths given for the English ships. The tables show a steady increase in dimensions and tonnage, but a more than proportionate increase in the extreme breadth. The sudden increase in depth of hold in the three classes in 1745 is to be ascribed to the increase in height of the lowest tier of guns above water. Since the guns were at a fixed distance above the deck on which they were fitted any increase in the height of the guns above water raised the deck the same amount and increased the depth of hold which was measured from that deck. The draughts of water in the various establishments generally show an increase, but very much less in proportion than that of the breadth.

This standardisation of dimensions probably did more harm than good, for it prevented freedom of design and consequent improvement. Such a procedure is wholly justifiable when the object to which it is applied is fully developed and no changes are likely in its qualities. The sailing warship, and especially that of the largest size, had not attained such a stage and was comparatively in the infancy of its development. Changes were continually being suggested as the result of experience at sea and in battle. Guns were being increased in calibre and other particulars. The 90-gun ship of 1706 had a broadside discharge of 800 lb., whilst that of 1760 had 900 lb. The 80 and 60-gun ships had their broadside discharges increased from 660 lb. and 315 lb. to 770 lb. and 490 lb. respectively in the same time. The increase in weight of guns and mountings was in proportion, and this alone required a proportionate increase in the dimensions of the ships.

Another change was in the sails which a ship could set. In 1705, fore and aft head sails in the form of jibs were introduced, and the number and size of these sails increased as experience in working them at sea was gained. Increase in speed was then, as now, always required, and this demand led to a gradual increase in the area of sails already carried. Both the introduction of new sails and the increased area of the old necessitated an improved stability. Figures as to the increase in sail area are difficult to obtain, but it has been stated that the Royal Sovereign of Phineas Pett carried 45 per cent. of the sail area of a ship of the same dimensions built in 1840, and from the nature of the case the increase was gradual.

Even the most far-seeing members of a Commission could not be expected to anticipate developments of the kind referred to above, and to allow for them in the dimensions to be given to warships. The Establishments of dimensions, although probably correct at the time they were promulgated, became obsolete in a very short period. No further attempts to standardise dimensions were made after 1745.

An extract from a letter written by the Admiral in command of the Mediterranean Fleet in 1743 is interesting as showing the action taken by officers to improve the stability of the ships they commanded: "Two 90-gun and three 80-gun ships can use their lower ports in a capful of wind; the others cannot. Rowley in the Barfleur had to run his weather guns out and lash 30 tons of water on his weather side and let go his lee anchor before he could keep the lower lee ports open."

In 1684, Sir Richard Haddock, Comptroller of the Navy, directed an inquiry into the cubical contents of warships below the third rate. The letter to the Master Shipwrights stated, "I cannot conceive a competent breadth can be in any degree prejudicial to a ship's sailing, it being the sole dimension which makes them stout under sail."

According to his directions the draughts of the ships when launched were to be observed, the displacement was to be calculated, and from it the weight of hull was to be determined. When complete, the draughts were observed, and the displacement was calculated. The difference in the latter figure gave the weight of the equipment. Deane's "secret" already referred to was employed for the calculations, and as a result useful information was obtained for future designs. Charnock considers these instructions were "the first step towards uniting a philosophical theory with the science of naval architecture."

The inquiry showed that a fourth-rate vessel of

* No. II. appeared August 4th.

* Boate explained that the dimensions to which he was to build the Unicorn were given him by the Admiralty and that he increased the beam by 20in. As a result of the trouble with the Unicorn, the Admiralty decided that the dimensions of new ships were to be determined by a Committee of Naval Officers, Master Shipwrights and their assistants, and representatives of Trinity House and the Shipwrights' Company.

50 guns had a displacement of 855 tons, a weight of hull of 415 tons, and of ballast 90 tons, or a little more than 10 per cent. of her displacement. The tonnage was 660, and the ratio of beam to draught 2.5. A ship mounting 30 guns had a displacement of 380 tons, a weight of hull 160 tons, and of ballast 50 tons, or 13 per cent. of her displacement.

A Large New Rolling Mill Shop in Sheffield.

A large new rolling mill shop has recently been equipped at the East Hecla Works of Hadfields, Limited, of Sheffield. The total area covered by the complete plant is 175,000 square feet, or just over 4 acres, the rolling mill shop itself occupying an area of 80,000 square feet, or 1.75 acres.

The building in which the mill is now installed is one of several large structures erected by Messrs. Hadfields during the war period, this particular building having been devoted to the manufacture of high-explosive shells of 15in. calibre and upwards. To meet the present requirements the length of the building has had to be extended sufficiently to accommodate the new 28in. mill, furnaces and other appliances. As now completed it comprises three bays lettered A, B and C, each having a crane span of 51ft. 3in. between centres of rails, with a height from the floor to the level of crane rails of 22ft. 6in. and a total length of 504ft. The building was designed for overhead electric travelling cranes of 20 tons capacity, but owing to the heavy weights dealt with in handling the parts of the large driving motor for the rolling mill it was found necessary to remove the crane girders in the original portion of bay A and to replace them by girders sufficiently strong to carry cranes of 35 tons capacity. A plan and cross section of the mill are given on page 135, while a set of views showing it and its electrical equipment appears in our Supplement.

Casting and Heating Arrangements.

The ingots to be rolled are cast from open-hearth furnaces in an adjacent building and conveyed hot on a transfer bogie into bay B by means of a 3-ton electric warping winch. The furnaces, which are illustrated in one of the views in our Supplement which shows the reheating furnaces from the discharging end, with the charging machine, and soaking pit, embody all the latest modern improvements. The two furnaces are of the gas-fired reversing regenerative continuous type, each having a hearth 6ft. 6in. wide and 50ft. long. The charging pusher is hydraulically operated. The soaking pit is also of the gas-fired type and has gas and air reversing regeneration. Its dimensions are 36ft. 6in. long by 6ft. wide at the top and 5ft. at the bottom, 5ft. 6in. deep, and it is capable of holding twenty-four ingots. It is arranged with rolling lids operated by hydraulic cylinders.

The continuous furnaces are intended for heating up cold ingots. In the case of some special steels it is essential to heat up the ingots gradually from a cold to a rolling temperature, and for that operation the type of furnace employed is specially adapted. The engraving also gives a clear view of the 2-ton overhead charging machine operating in bay B for the conveyance of hot ingots from the transfer bogie to the soaking pit and thence, after re-heating, to the mill. A 4-ton low-ground type ingot charging machine extracts the hot ingots from the discharging end of the continuous furnaces and deposits them on a stand close by, from which they are picked up by the overhead charging machine and taken direct to the mill. This machine with its rail track can also be seen in the engraving. A gravity roller track links the soaking pit with the continuous furnaces. It is equipped with an automatically operated tippler chair for the purpose of transferring from bay B to bay A surplus cold ingots requiring to be re-heated. The charging machine, roller track and soaking pit were supplied by the Wellman Smith Owen Engineering Corporation, Limited.

The main control platform is on the approach side and spans the entire width of the mill. On it are fixed the controls for the mill motor, the motors driving the ingoing and outgoing live rollers, skids and screw-down gear, the hydraulic controls for the manipulators, together with the requisite electrical instruments. A platform is also arranged between bays B and C beyond the hot saw, on which are situated the controls for the motors driving the run-out to the saw and the run-out beyond; the skids at the cooling bank, the hot saw, with the hydraulic controls for the sliding carriage of the saw and the cylinder operating the lifting fingers at the tank.

The mill plant, which was supplied by the Brightside Foundry and Engineering Company, Limited, Sheffield, is capable of rolling down 15in. square steel ingots 5ft. long, having a weight of 25 cwt., reducing them at one heat to 2¾in. square billets. The normal output will be approximately 1500 tons per week of 110 working hours, or, say, 15 tons per hour, with a maximum output of 20 tons per hour for occasional short periods. The mill will also roll Hadfield "Era" manganese steel ingots into rails up to the heaviest section in demand, having a maximum length of 55ft. rolled—say, 45ft. finished. It will also roll steels containing up to 0.8 per cent. carbon or more. As a result of the close co-operation between Messrs. Hadfields and the manufacturers, the mill has been designed on very liberal lines to deal satisfactorily with steels of the special nature required, and in this respect it is unique for its size. It is equipped with all the necessary improvements and labour-saving devices to obtain the most economical production, being in fact far in advance of the type of mill now generally used. Another of the views in our Supplement shows the pinion housing and the roughing and finishing stands. The cogging rolls are 28in. in diameter by 7ft. long, while the finishing rolls, which are also 28in. in diameter, are 6ft. 6in. long.

The Electric Motor.

The mill is electrically driven and the motor is connected to the bottom pinion by a coupling of the "Ortman" sliding type, which is constructed entirely of steel and the engaging portions of which are renewable. It can be engaged or disengaged by hydraulic gears, so that it can run independently of the mill for testing or other purposes. The pinions, which are 32in. in diameter and 42in. on the face, are of high-grade carbon forged steel and have machine-cut double helical teeth. They are fitted with replaceable wobblers and are mounted in a totally enclosed cast iron housing furnished with anti-friction metal-lined bearings. The teeth of the pinions are lubricated as near the point of contact as possible by specially arranged trays or spreaders, and the oil for the pinions and bearings is kept in continual circulation by means of a motor-driven rotary pump. The spindles between the pinions and the cogging rolls and between the latter and the finishing rolls are of forged steel having machined fluted ends. The top spindles are of the "Universal" type and are fitted with renewable phosphor-bronze wearing blocks and accurately balanced with cast iron weights, while the bottom spindles are supported in stationary bearings on springs. The ends of the spindles and the insides of the wobbler boxes are machined with a minimum of clearance to eliminate backlash as much as possible.

The housings for the cogging and finishing stands are of solid steel construction and are machined throughout on all fitting faces. They have cast steel chocks and forged steel renewable wearing plates, with provision for end adjustment.

The Main Rolls.

The main rolls were manufactured throughout by Hadfields and are of the firm's special quality high-grade carbon forged steel with machined fluted wobbler ends.

The upper roll of the cogging mill is arranged for a high lift, and is also hydraulically balanced. It is raised or lowered by means of a totally enclosed worm reduction screw-down gear, the power being supplied from a 40 horse-power motor, which is protected by a safety slipping device from exceptional overloads. The upper roll of the finishing mill is spring balanced and is arranged with hand screw-down gear. The cogging and finishing housings, together with the pinion housing, are mounted on a cast iron bed frame, the section under the roll housings having an inverted V type of face, while that under the pinion housing has a flat face. The bed frame is machined on the face and on the feet of the housings at the fitting points, so as to ensure perfect rigidity.

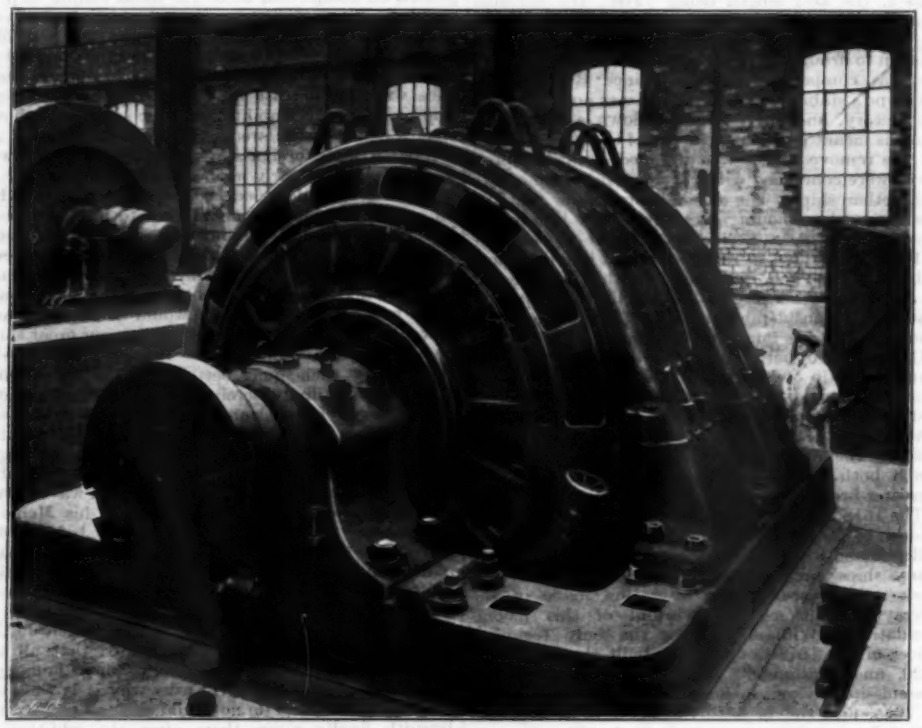
The live roller gear for the cogging mill has a cast iron frame of heavy design, the driving side of which is in the form of a trough with both roller and line shaft bearings formed in one piece. For the finishing mill, the rollers of which are at a greater distance apart, a mild steel framing, on which separate enclosed gear cases are mounted for each pair of mitre wheels, is provided. All gear-boxes have dust-proof covers, and in all cases the bearings are of the ring oiling type, and the mitre wheels of cast steel. All the live rollers are turned on the barrels and are of cast iron, with the exception of the first four rollers on either side of the main cogging rolls and the first two rollers at the approach end of the ingoing side, which are of cast steel. The live rollers are driven by 40 horse-power motors through the medium of totally enclosed machine-cut reduction gears, having ring-oiling bearings.

Bloom Shearing Plant.

The hydraulic shears, which work in conjunction with an hydraulic intensifier, are of the up-cutting type and designed for a maximum power of 1000 tons. They are designed to shear "Era" manganese steel blooms, when hot, up to 10in. square. The main castings are all of steel, with the exception of the base, which is of iron, and the shears are arranged for working at a pressure of either 1 ton per square inch without the intensifier or 2¼ tons per square inch with the intensifier. The main ram is 24in. diameter and provision has been made for varying the gap between the knives to suit the size of bloom being cut so as to save useless travel of the main ram. The intensifier is of the telescopic type and has differential rams 8in. and 12in. diameter, with a maximum stroke of 7ft., which gives 9in. travel of the shear blades under intensified pressure. The hot saw, which is of the horizontal sliding type, has a blade 60in. in diameter and is driven by a 75 horse-power motor by means of two belts from pulleys mounted on an extension to the motor shaft. The saw spindle and motor are mounted on one carriage, which slides forwards and backwards and is operated by power from a hydraulic cylinder. The saw blades can be changed without removing the spindle from its bearings. The skids are arranged with wire ropes passing round spiral drums at the driving end and single-grooved pulleys at the opposite end, tension screws and springs to take up the slack in the ropes being provided. There are rails with stools for carrying them on which the skid carriage travels to and fro. In the skid gear between the cogging and the finishing mills the skid is clipped to the rope and slides on the rails, whereas the skids at the cooling bank are in the form of a carriage, to either end of which is attached the rope. The carriage is furnished with wheels to run on rails, and the skids are of a balanced type free to fall over when passing underneath the bar lying on the live rollers, and to recover an upright position when the time comes to push the bar forward. The spiral drums are attached to a long shaft which is driven by a 40 horse-power motor, by means of totally enclosed reduction gears of the same type as those driving the live rollers.

The Mill Motor.

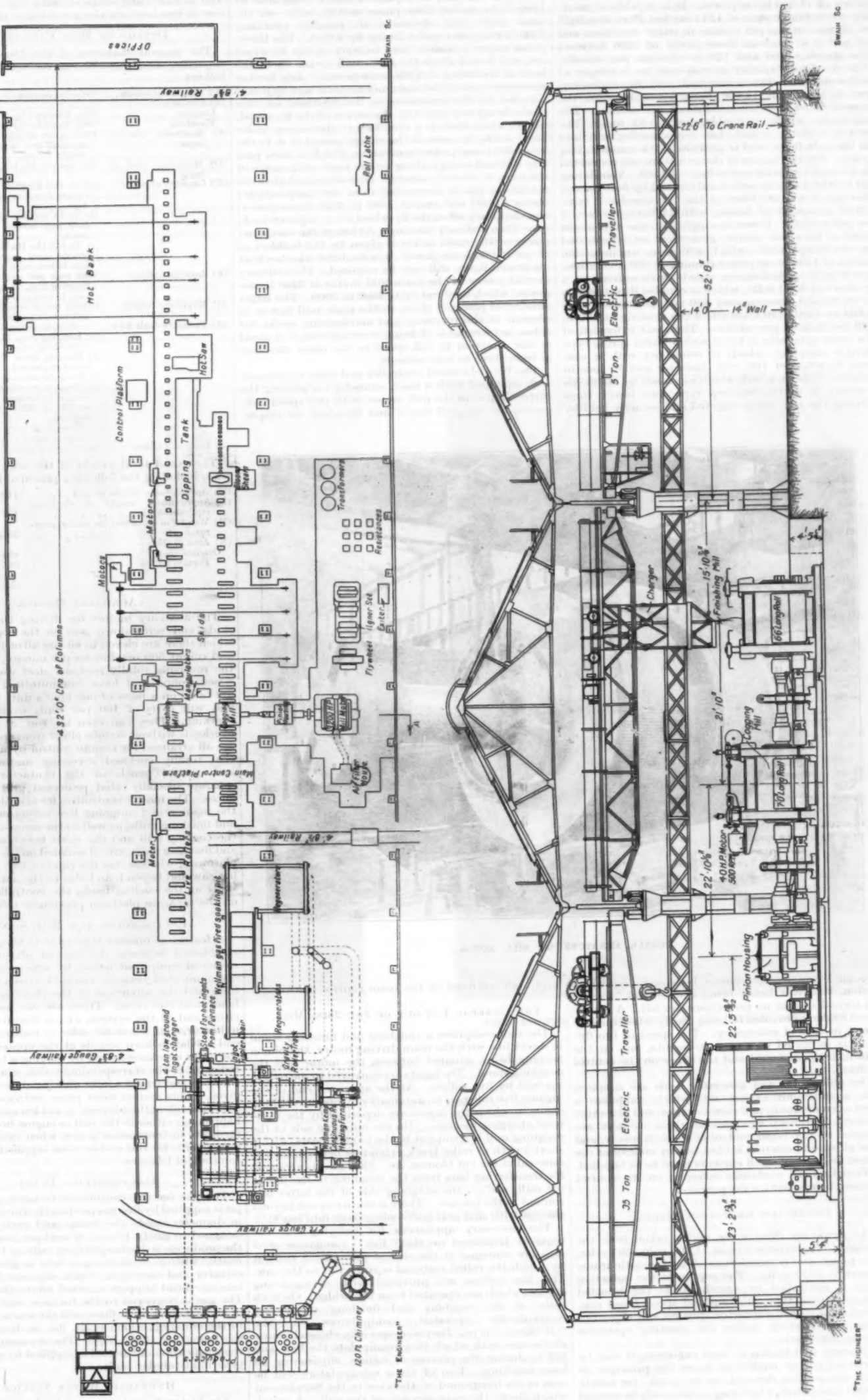
The mill motor, which was built by the British Thomson-Houston Company, Limited, and which, with its armature, are illustrated herewith, has an



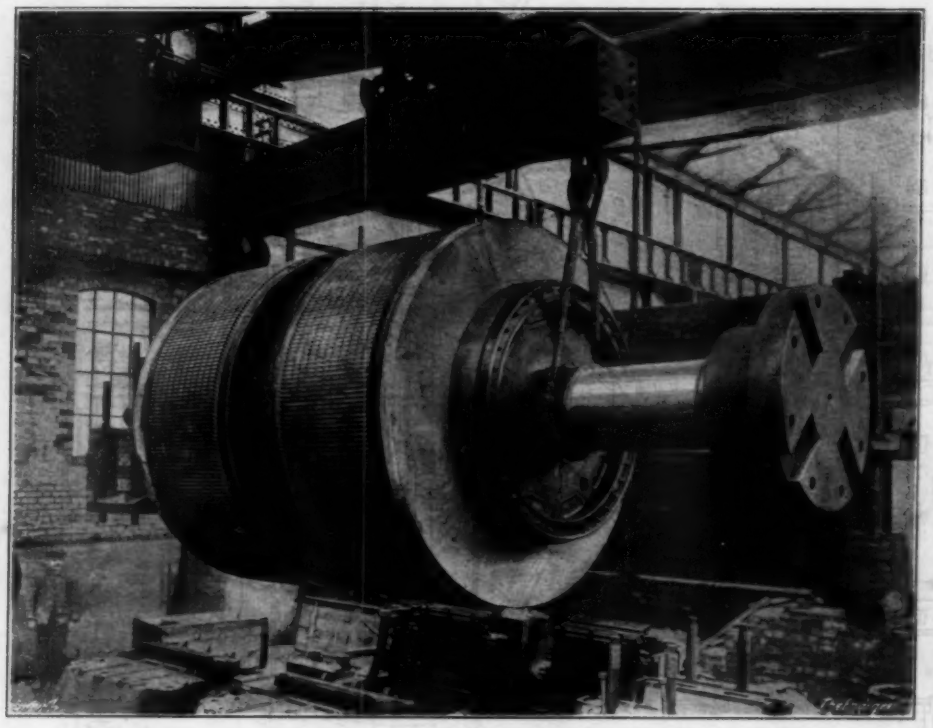
THE 3,200 HORSE-POWER MILL MOTOR

PLAN AND CROSS-SECTION OF 28-INCH ROLLING MILL AT EAST HECLA WORKS, SHEFFIELD

(For description see opposite page)



R.M.S. rating of 3200 horse-power and a maximum rating of 11,600 horse-power. It is capable of exerting a constant torque of 125 tons-feet from standstill to 60 revolutions per minute in either direction, and of giving a constant horse-power of 3200 between the speeds of 60 and 120 revolutions per minute. The overload capacity corresponds to a torque of 453 tons-feet between standstill and 60 revolutions per minute, and 11,600 horse-power between the speeds of 60 and 120 revolutions per minute. The armature, which is double, weighs 62 tons. The motor is shunt wound, has compensating windings in the pole faces, and is provided with commutating poles. The two halves of the armature are connected in series for a maximum voltage of 1300. Ventilating air for the motor is cooled and cleaned by first passing through a wet air filter of the "Invincible" type, which is capable of dealing with 25,000 cubic feet of air per minute. Power is supplied to the mill motor from a fly-wheel motor generator set—illustrated in our Supplement—which comprises an induction motor of 1800 horse-power running at 600 revolutions per minute—synchronous speed—with current at a pressure of 3300 volts, which is coupled direct to two shunt-wound compensated 650-volt generators each rated at 1300/4750 kilowatts when running at 500 to 600 revolutions per minute. The shaft extension of the outer generator is fitted with a buffer spring type flexible coupling, which is connected with a cast steel fly-wheel of 11ft. 6in. diameter and 30 tons in weight. This fly-wheel, which was made by Hadfields Limited, is of the built-up type, two heavy rings forming the rim, being spigoted and securely held by



DOUBLE ARMATURE OF MILL MOTOR

through rivets to the central boss and disc wheel portion, the rivet heads being countersunk, riveted and turned so that no projections are left. A water-cooled brake is provided to bring the fly-wheel quickly to rest in case of emergency. The speed of the fly-wheel is indicated on two instruments, one on the main instrument board and the other on the control platform.

The mill motor and generator fields are supplied from a three-unit exciter set, which comprises a direct-current motor, mill motor exciter, and generator exciter. The field windings of these exciters are designed to give rapid control of the mill motor, and since all speed variation is obtained by control of the exciter fields, only small currents have to be handled, a Ward-Leonard controller mounted on the control platform being used for the purpose.

Power for Emergency Needs.

The power for driving the mill is taken from the Sheffield Corporation mains at 11,200 volts, 50 cycles, three-phase, and is transformed down by static transformers to 3300 volts. The supply to the induction motor is controlled by switchgear of the ironclad draw-out truck type, starting and speed being controlled by a special contactor starting and slip regulating panel, which makes the starting operation entirely automatic.

Although well known to most engineers, it may be interesting to our readers to know the principle on which the sudden demand, so to speak, for nearly 12,000 horse-power, which may occasionally be wanted in connection with the working of this mill, is met. The fly-wheel set, as explained above, comprises an 1800 horse-power three-phase motor, with—on the same shaft—two dynamos of, roughly speaking, 6000 horse-power and a 30-ton fly-wheel. The three-phase motor is mainly used to start up the fly-wheel set, and it will drive the main mill motor up to the limit of its rating of 1800 horse-power. Any further resistance against the main mill motor is met by power supplied by the generators on the fly-wheel set, this power being developed by the action of the fly-wheel, which, when there is a tendency to slow down under load, yields up some of the energy stored in it to the two 6000 horse-power generators, which in turn pass this released energy along to the main mill motor in the form of electric current. It is estimated that the maximum power demanded from the Corporation's mains should not exceed 1800 to 2000 horse-power, and that, only when the fly-wheel set is required to do more than ordinary running. Although the maximum power of the main motor is given by the builders as about 12,000 horse-power, it is doubtful whether that maximum figure will ever be required. The ordinary normal power of the main mill motor is 3200 horse-power, which may run up to 4000 to 5000. The larger amount of power is given to the main mill motor on account of the reversing and accelerating needs, for it has to be capable of being reversed from full speed in one direction to full speed in the other direction in from three to four seconds.

The Ward-Leonard controller and main instrument desk equipped with a main ammeter for reading the current input to the mill motor, with two speed indicators, for the mill motor and fly-wheel set respectively, are all fixed on the main control platform.

The General Lay-out of the 28in. Mill.

The mill comprises a roughing and finishing stand in direct line with the main driving motor, the pinion housing being situated between the motor and the roughing stand. The ingots are conveyed to the roughing mill by live rollers. At the approach end of the ingoing live rollers is an automatically operated tilting chair, in which the ingots are deposited by the overhead charging machine. On the outgoing side of the roughing mill is a run-out to the bloom shears, with a short length of roller track extending beyond, for the removal of the cut blooms, &c. Skid gear is arranged for transferring bars from the roughing to the finishing mill, and on the outgoing side of the latter is a run-out to the hot saw. There is also a run-out beyond the saw with skid gear and cooling bank into bay C.

The necessary appliances for carrying out the requisite treatment on the "Era" manganese steel rails are arranged at the side of the ingoing run-out by which the rolled material is conveyed to the saw. The live rollers are provided with manipulating devices which are operated from the bridge. On both sides of the roughing and finishing stands are hydraulically operated manipulators of the "Williams" type. They were specially chosen because of the ease with which they manipulate the bars and billets during the process of rolling, eliminating all man handling. Two of these manipulators will be seen in the foreground of the view in the Supplement which shows the outgoing side of the mill. A switch giving remote control of the main circuit breakers, as well as indicating lamps showing the operation of the circuit breakers, are also provided on the control desk.

Details of Mill, Capacity, &c.

The general character of the 28in. mill with its capacity, &c., may be conveniently tabulated as follows:—

(A) Number of stands	Two, *i.e.*, one cogging and one finishing
(B) Size of rolls—	
Cogging	28in. diameter by 7ft. long
Finishing	28in. diameter by 6ft. 6in. long
(C) Maximum size of ingot	15in. square at large end, 13½in. square at small end, 4ft. 6in. to 5ft. long, weight 25 cwt.
(D) Minimum size of ingot	9in. square, 4ft. long
(E) Capacity of mill	(*a*) To roll Hadfield steel ingots 15in. square down at one heat to billets, 2½in. square (*b*) To be capable of rolling the Hadfield high-carbon and special alloy steels (*c*) To roll the Hadfield "Era" manganese steel ingots, 13in. square into billets, rails, &c.
(F) Average output	1500 tons per week of 110 working hours of 2½in. square steel billets, or say, 15 tons per hour
(G) Maximum output	20 tons per hour of 2½in. square steel billets for occasional short periods
(H) Products dealt with	Of mild and special steels: (*a*) Ranging from 8in. to 2½in. billets in finishing stand (*b*) Ranging from 8in. to 5in. billets in cogging stand (*c*) Irregular sections as required (*d*) Manganese rails up to the heaviest section in demand and a maximum length of 55ft. rolled, say, 45ft. finished (*e*) Blooms of any size within the range of ingot
(J) Length of billets	Any length required to suit ingot

The grand total weight of the mill is about 1600 tons, including the following principal items:—

(K) Approximate weight of mill	1100 tons
(L) Approximate weight of electrical equipment	400 tons
(M) Weight of fly-wheel on motor generator set	30 tons
(N) Area of shop—	
Original shop	49,608 square feet
Portion added	26,730 square feet
	76,338, or 1.75 acre

Auxiliary Motors.

The auxiliary motors for driving the live rollers, skids and screw-down gear on the cogging rolls, of which there are eleven in all, are all of 40 horse-power and run at 500 revolutions per minute. They are of the reversing totally enclosed steel works type, are series wound and have commutating poles. They are rated on a basis of one hour's duty for mill work and will carry a 100 per cent. overload without sparking. They can even be run at still greater overloads without serious effect from sparking. They are all arranged for remote control by means of ironclad totally enclosed reversing master controllers and control panels of the contactor type, with separate specially rated protected grid type resistances. The master controllers for the motors driving the ingoing and outgoing live rollers of the cogging and finishing mills, as well as the screw-down gear for the cogging mill and the skids between the cogging and finishing mills, are all situated on the main control platform; whereas, for the run-out live rollers to the hot saw and beyond, and also to the hot saw and the skids at the cooling bank, the controllers are fixed on the separate platform previously referred to.

Engine-house and Mill Signals.

A feature of interest is an electric telegraph system established between the control platform and the electrical equipment house, by which orders may be communicated between the mill driven on the platform and the attendant in the electrical equipment house and *vice versâ*. There are two instruments at either end of the system, *i.e.*, a transmitter and an indicator, and when an order is transmitted at one end a Klaxon horn sounds at the opposite end until the order is acknowledged by moving a handle on the indicator to the corresponding order, when it cuts out the horn and leaves a light glowing showing the order given. This system must prove extremely useful in case of accident, breakdown or sudden and unexpected happenings either in the mill or engine-house, and will facilitate instantaneous action when called for. The instruments for this system were supplied by Mechans Limited, of Glasgow.

Gas-producing Plant.

The gas for the continuous furnaces and soaking pit is supplied by five gas producers, which are 8ft. 6in. in diameter inside the lining, and each of which is designed to gasify 10 cwt. of coal per hour. Coal for the producers is discharged from railway trucks underneath, whence it discharges into a gravity bucket elevator and conveyor, which deposits the material into overhead hoppers situated above the producers. The gas is conveyed to the furnaces and soaking pit in underground brick flues, and the waste gases travel to the chimney, which is 5ft. 9in. in diameter, inside the lining, by 120ft. high. The necessary steam for the gasification of the coal is supplied by a locomotive type multitubular boiler.

Hydraulic Water Service.

The hydraulic water service to the mill is arranged for a working pressure of 1 ton per square inch and is

supplied by a set of three-throw pumps having 3¾in. diameter rams, 15in. stroke, which are driven by a 175 horse-power motor, running at 375 revolutions per minute, through the medium of totally enclosed machine-cut double helical reduction gear. These pumps deliver to an accumulator having an 18in. diameter ram with a 20ft. maximum stroke, the pressure water from the latter being delivered by a 2½in. diameter steel main to the mill, and the return water from the mill by a 4in. diameter wrought iron main. The starting panel for the pump motor is of the enclosed contactor type. It is controlled by a tappet switch actuated by the rise and fall of the accumulator. The latter also works a pilot valve which operates a by-pass and non-return valve on the pumps, thus enabling them to be started up unloaded.

The pumps are housed in a brick building a short distance from the mill. It has a hand-operated overhead travelling crane for handling the machinery.

Finish of Floor of Mill.

In concluding the description of the rolling mill plant reference may be made to the neat manner in which the floor surrounding the mill is finished off. All the live roller gear, which at the finishing mill has a length of 320ft., is below the floor, which hence presents an even plated surface all over, with the exception, of course, of the live rollers, which necessarily project slightly above the floor level.

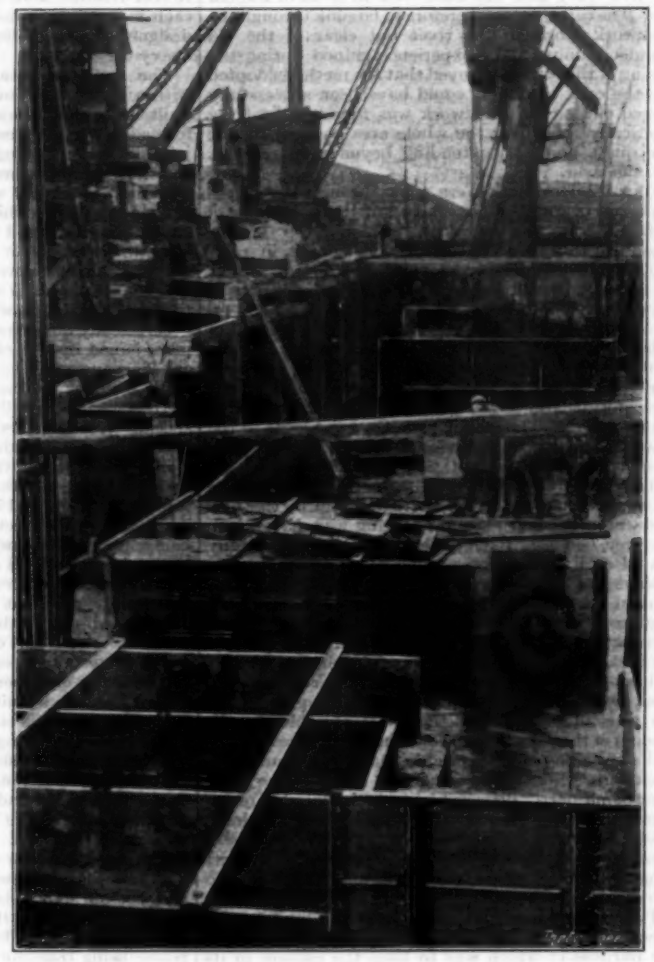
Two Smaller Rolling Mills.

Messrs. Hadfields have also just recently installed two new rolling mills, one 11in. and the other 14in. These mills are of the continuous-running bar type, and each driven direct by an electric motor, having a fly-wheel and flexible coupling interposed between the motor and the mill. They are complete with the usual reeling machines, shears and hot saws, &c., all driven by individual electric motors, each machine being situated in the best possible position for handling the material in the progressive stages after leaving the rolls. There is also a roll-turning department, furnished with electrically driven roll-turning lathes and a full equipment for turning rolls. The furnaces for heating the billets before entering the rolls are of a patented semi-gas recuperative design.

There are overhead electric travelling cranes for for handling the raw and finished materials, and also for changing the rolls, &c. Both mills are specially designed for dealing with high-carbon and other special alloy steels, also with "Era" manganese steel, and are consequently of an exceptionally robust character so as to withstand the abnormal stresses arising from the rolling of such steels.

The main features of the two mills are as follows:—The 11in. mill is arranged with five sets of housings, *i.e.*, one three-high and four two-high. It is driven by a 400 to 800 horse-power compound motor having a rated speed of 150 to 250 revolutions per minute through the medium of a totally enclosed machine-cut double helical reduction gear to reduce the speed of the mill to a minimum of 110 revolutions per minute. Interposed between the reduction gear and the motor is a cast steel fly-wheel, 10ft. diameter, having a weight of 17 tons. A buffer spring type flexible coupling connects the motor shaft to the fly-wheel shaft and a concentric type of coupling connects the fly-wheel shaft to the reduction gear. The starting panel for the motor is of the contactor type. The mill is designed to roll 2½in. billets to rounds of from 1¼in. to ¼in. diameter and to squares of from 1¼in. to 1in. side, also to flats of equivalent section within the capacity of the mill, and other special sections as required. The 14in. mill is arranged with six sets of housings, two-high, driven by a 500 to 1000 horse-power compound motor, having a rated speed of 75 to 150 revolutions per minute, the rolls running at the same speeds. Interposed between the mill and motor is a cast iron fly-wheel, 12ft. diameter, having a weight of 40 tons. A buffer spring type flexible coupling connects the motor shaft to the fly-wheel shaft. The starting panel for the motor is of the contactor type. The mill is designed to roll 5in. billets to rounds of from 3in. to 1in. diameter and to squares of from 3in. to 1in. side, also to flats from 7in. to 1in. down, and other special sections as required. We may add that the whole of the steel castings and forgings used in these mills are of the Hadfield best cast steel.

AIR LOCKS AT PLANTATION QUAY



VIEW SHOWING PIER CONSTRUCTION AND CAISSON BEING SUNK

Rebuilding Quay Walls at Glasgow.

An engineering undertaking of more than ordinary difficulty has just been carried out at Glasgow Harbour. It was the reconstruction of portions of old quay walls which collapsed and fell into the harbour some years ago. Apart from the difficulty always associated with the putting down of secure foundations through sandy sub-strata the engineers had to deal with problems arising from the vast amount of *débris* lying on the bed of the river as a result of the collapse of the old walls, and also the fact that the stumps of the old foundations remained in most cases in the positions in which they were constructed over half a century since. Portions of three quays at different parts of the harbour gave way about five years ago; one at Anderston Quay on the north side of the river, and the others at Mavisbank Quay and Plantation Quay on the south side. The contract for reconstructing Plantation Quay was secured by Sir William Arrol and Co., Limited, Glasgow, whilst the Clyde Trust's own engineering department, under the direction of Mr. Donald, attacked the other two walls. Of the work carried out at Plantation Quay by Arrol and Co., an interesting account was given recently by Mr. N. Kingsley Dickie, of the firm's engineering staff, in a paper read by him to the Glasgow Association of Students of the Institution of Civil Engineers. In that paper Mr. Dickie outlined the main features of the work of reconstruction. For the better understanding of the problems with which the contractors had to deal, Mr. Dickie gave a description of the old quay wall. It was originally built, he said, in 1870, and at that time the well sinking system of foundations was adopted at several of the Glasgow docks, including Plantation Quay. There single-brick cylinders were used for 403 lineal yards of wall. The system was further developed in the extension of the quay by the adoption of concrete caissons having triple cylinder wells; two wells of the group being placed at the river face, and the third at the back between the two in front. The cylinders, which were 12ft. in external diameter, were formed with brick rings 2ft. 6in. in depth and 2ft. 4in. in thickness, giving an internal diameter of 7ft. 4in. They were built on a platform and brought forward for putting together. Tongues, 16in. in length by 4in. in depth, were formed in the brickwork to key the cylinders together, a corresponding groove being formed on the adjoining cylinder. A cast iron shoe joined the bottom edge of the cylinder and on this the brick rings were built. Grabs were used to remove the material from the inside of the cylinders, and as they sank more brick rings were added until the cutting edge had reached the required depth. The cylinders, which were 36ft. 7in. in height, were founded at about 52ft. below cope level, the top of the cylinder being about 2ft. above low water at the time of construction. When all the material inside was excavated the bottom was plugged with concrete, on the top of which sand filling was added.

To obtain a proper footing for the superstructure a cast iron lintel was laid from cylinder to cylinder on the river side and a stone lintel on the land side, and transversely across the centre of each cylinder an iron girder was fixed at right angles to the line of the quay. On this base the superstructure of the quay wall was built. It was 11ft. thick at base, and was hollow over the cylinder wells. The wall was anchored back to blocks of masonary by tie rods 2½in. in diameter, placed 24ft. apart.

On December 16th, 1917, a portion of this quay fell forward into the river, the distance between the centres of the last standing cylinders being 351ft., giving twenty-seven broken cylinders. When the wall collapsed it took with it the goods shed which was erected on the quay. The majority of the cylinders were broken across a short distance below low water, leaving the bottom portions in most cases leaning forward toward the river. The displacement at the top of the remaining portions of the cylinders varied from a few inches to 12ft. in front of the original line. The steel work of the shed and other loose *débris* were removed by divers, but the brickwork of the fallen quay could not be dealt with in this way except with difficulty and at great expense. But even had it been possible it would not have been advisable to remove any of this material, in view of the risk of causing the collapse of the old cylinder stumps, and probably also extensive damage to the roadway immediately behind the quay, on the opposite side of which there stands a heavy two-storey dock shed.

The collapsed wall, lying in very large pieces of brickwork on the bed of the river immediately in front of the original quay, made the problem of reconstruction a somewhat difficult one, as it was found to be impossible to drive piles with any uniform spacing, and monolith construction was also out of the question. It was therefore decided to use pneumatic caissons, and in order to give more land space for a wider shed, the new quay line was fixed 31ft. in front of the old line. The caissons had therefore to be sunk through the brickwork *débris* in the river but clear of the old cylinder stumps. The experience gained during the sinking of the caissons proved that the method adopted was the only one that could have been successfully carried out, as the brickwork was found to be lying practically solid over the whole area covered by the new quay, and also extending beyond the caissons into the river.

Four steel caissons were sunk through the brickwork, one of 100ft. in length, two of 104ft., and one of 64ft. all 24ft. 6in. in width. On the top of the caissons a mass concrete wall is constructed, in piers 15ft. in breadth, spaced at 36ft. centres, with intervening curtain wall at back. The piers are carried up to cope level, but the curtain wall finishes about 3ft. above low water. The superstructure is composed of a decking of reinforced concrete, carried by heavily reinforced beams, spanning from pier to pier, and from piers to clusters of reinforced concrete piles at the back of the quay, with intermediate beams supporting the floor slabs. The height from the cope level to the cutting edge of the caisson is 56ft. 2in., which provides for a depth at high water O.S. tides of 36ft., as against 30ft. in the original structure.

In order to provide access to the site of the new work, an inner and an outer staging was driven into the river, between which the caissons were successfully floated and sunk. These stagings carried the guide timbers for the caissons and supported the baffle boards used in levelling the river bed. The driving of the stagings proved to be much more difficult than was anticipated. The river bed was strewn with pieces of the broken cylinders, many being of considerable size, and piles could only be driven where gaps were found. The piling required to be in accurate line up and down the river, but some latitude was possible in the spacing of the piles in each row, and trials were made to find a suitable place for pitching each pile clear of the brickwork. Notwithstanding this, many of the piles, after being partly driven, had to be replaced three or four times before a reasonably sound one was obtained. Over certain areas only a few feet of driving was possible, and these piles merely serve to support gangways and platform, and could not be relied on to carry any great load.

Two of the soundest piles on each staging were selected, and to these the rubbing timbers were fixed, the purpose of which was to keep the caisson in its correct position for sinking, and to prevent any portion of the staging being fouled by the caisson as it rose and fell with the tide before the requisite weight was added to keep it grounded.

Three stagings were constructed as described for caissons Nos. 1, 2, and 3. For caisson No. 4 the staging also served for the building and lowering of all the caissons, and was consequently made considerably heavier. This site for building and lowering was chosen because, so far as could be ascertained, the river bed at the place was clearest of *débris*. The more usual method of building and lowering the caissons exactly over the positions they are designed to take in the final structure was therefore abandoned, and one building site for all the caissons adopted, arrangements being made to float the caissons successively into their respective sinking positions. In addition to closer spacings, groups of piles were driven to carry heavy timber trestles, which in turn supported the steel lowering girders.

It being essential that each caisson should ground on a level bed, weighted baffle boards were sunk alongside the outer staging clear of the cutting edge of the caisson, and resting on the staging piles. The space inside was brought to a uniform level round the line of the cutting edge of the caisson by means of old bags filled with ashes. In some cases there was a difference of level of 12ft. between the land side and the river side of a caisson, and to complete this very important work 34,000 bags were deposited in the river. In the early stages, attempts were made to level the brickwork by drilling and blasting, but this process was discontinued as it was found to be of little use.

The caissons consisted of mild steel shell plating stiffened at the top by roof girders, to the under side of which steel plating was riveted. The roof girders spanned the full width of the caisson and were braced together at intervals by diaphragms. The space below the roof girders formed the working chamber, and its sides were stiffened by brackets riveted to the outer shell. On the inside of these brackets a skin plate was attached, this plate extending from the end of the roof plating along the bracings to the outside shell where it joined a heavy plate which formed the cutting edge. Four heavy brackets were bolted to the roof girders for lowering the caissons, and a heavy angle was placed along the top of the shell plate to which the temporary caisson referred to below was attached by long bolts. In the large caissons three air shafts, and in the smaller caisson two air shafts were riveted to the roof plate between two of the roof girders, additions to the height of the shafts being made as the caisson sank. After the permanent caisson had been assembled it was riveted and caulked, and when complete it was lifted clear of the supporting timbers, the removal of which left a clear space for lowering the caisson into the river.

For lifting, suspending, and lowering the caissons, four 120-ton hydraulic jacks were used, supported on two pairs of heavy steel girders which rested on four timber trestles, 20ft. high above the staging, two on each side of the caisson. The jacks were specially designed by Sir William Arrol and Co. to deal with heavy caissons.

The temporary caisson served as a cofferdam, within which the concrete wall and piers could be built up without hindrance from the tide. It was formed of steel panels of varying length, the adjoining sections being securely bolted together. In the first instance three tiers of panels were erected, and the whole shell was attached to the permanent caisson by bolts, which were so designed that they could be disengaged later on when the permanent structure was below water level. The sides of the temporary caisson were braced together with lattice cross girders, and to resist the outside water pressure three sets of timbers were fixed inside temporarily.

As already mentioned, the new wall is in the form of piers joined by a back curtain wall. The temporary caisson panels formed the shuttering for the concrete along the back, but separate shuttering was necessary at the face of the walls and piers, and for this purpose special steel shutters were constructed in standard lengths to suit the dimensions of the pier and back wall. The steel shuttering was made of light plates and angles in sizes that could be easily handled, and it proved economical in use, both from the speed with which it could be erected and its freedom from repairs, being practically indestructible as compared with timber shutters. As concreting continued, the extra weight gradually increased the draught of the caisson, and finally sufficient deadweight was obtained to keep the caisson on the bed of the river at all states of the tide. When this occurred the air shafts and locks were erected, and compressed air was pumped into the working chamber, care being taken to regulate the air pressure to suit the variations in the tide level. The men were thus enabled to descend on to the river bed and begin sinking operations.

The manlock consisted of two chambers, the inner of which was virtually an extension of the access shaft, and always under the same air pressure as that in the caisson. The lock was specially designed by the contracting firm. The material lock for removing the excavations was situated immediately above the manlock, and consisted of one compartment with top and bottom doors sliding horizontally. The motive power for hoisting the bucket was obtained from a winch placed outside on the wall of the lock, the power being transmitted into the lock by means of a shaft working through an air-tight gland.

At the commencement of sinking it was found that practically the whole area of the working chamber was covered with bagged material used for levelling the bed of the river; there was very little space between the surface of the bags and the roof of the working chamber. It was therefore first necessary to clean out this mass of bags and river slurry in order to obtain access to the cutting edge. The brickwork of the old wall lay inclined at a fairly steep slope across the site of the caisson, the side next the quay being considerably higher than the outer or river side. As the caisson settled on the prepared bed of bags, the outside support was relatively soft as compared with the inner, where bagged material had, as a rule, only been used to even out the inequalities in the brick *débris*. The inner cutting edge was therefore very soon resting on heavy masses of brickwork, through which it could not penetrate, and the outer edge generally travelled slightly lower before it became firmly borne by the bags. In addition to this cross fall, there was generally a slight longitudinal dip in the brickwork. To prevent the low edge sinking further as the working chamber was cleaned out, convenient spaces were first cleaned out and temporary packing inserted to support the caisson. Meantime the brickwork along the high edge had been uncovered and was removed by drilling and blasting, the caisson being gradually brought level in all directions. In the progress of the work special precautions were taken to prevent the caissons canting. The extent of the brickwork removed was very considerable. Pneumatic rock drills were used throughout and the brickwork was shattered by means of gelignite.

While sinking operations were in progress, the wall and piers were being gradually built up within the shelter of the temporary caisson. Here also extreme care was necessary, for, while the brick was being removed from beneath the cutting edge, the rate of sinking was extremely slow. Each fresh increase in height of wall and piers raised the centre of gravity, and increased the risk of the caisson canting, as at this period it had very little grip of the ground. To enable the concrete work to be continued without interference from the tide, additions were made to the temporary strakes as required. When the concreting had been carried up high enough to be above high-water level the tide was allowed to rise and fall within the cofferdam, all shores were taken out and the temporary caisson dismantled.

When the air locks were first erected the access shaft was 20ft. in length, but this had to be increased to complete the work of sinking. This was effected by temporarily supporting the caisson on timber packings before allowing the air to go off. Additional lengths of shafting were fitted, and the locks re-erected, after which sinking proceeded as before. The face of the piers on the new wall is vertical and special care had to be taken when founding the caisson to set the face line in proper alignment to avoid any projection which might foul ships moored alongside. As the founding level was approached special precautions were taken to keep the caisson under control, and no difficulty was experienced in setting it to the correct line.

The caisson being founded the working chamber was cleaned out and the bottom smoothed off, and on it concrete was deposited and firmly packed into the working chamber. Concreting was continued until the men gradually worked themselves into the air shaft, when strong grout was poured on the top of the concrete to fill up any voids. The air pressure was maintained for some hours to allow the concrete and grout to set, after which it was taken off very gradually. The final result was a monolith foundation of concrete enclosed in a skin of steel, and on this the base of the new quay wall was built.

The space between the adjoining caissons was 4ft. in width, and close to this gap steel sheet piling was driven in line with the back and front of the curtain wall. The enclosed pocket was grabbed out and concreted up solid.

In order to prevent tree trunks and other *débris* brought down by floods from lodging in the spaces between the piers and under the deck, timber fenders are placed at the front of the open spaces and inside the quay line. At their lower ends these fenders are carried on pre-moulded concrete walings built in from pier to pier at low water level, the upper ends being supported on the heavily reinforced beam which forms the cope girder.

To provide a support for the decking at the back of the quay reinforced concrete piles were driven in clusters of six, the centre line of each cluster being directly behind the centre line of one of the piers, and the piles being sufficiently far back to clear the inside edge of the stumps of the brick cylinders. Heavily reinforced beams span from pile cluster to pile cluster, and from piles to piers, carrying reinforced longitudinal beams which in turn support the deck slabs, on the top of which the floor of the new quay shed will be laid. On the centre of each pier a cast iron bollard is fixed, and this completes the new quay.

Some views of the work are given on pages 137 and 144.

THE MOTOR SHIP HANDICAP.

The motor ship Handicap is of unusual interest on account of her being the first motor vessel to be equipped with two-stroke cycle Sulzer marine Diesel engines, which are provided with turbo-blowers instead of the usual scavenging pumps. Built for Norwegian owners by Rosenberg Mekaniske Verksted at Stavanger, the Handicap has a length between perpendiculars of 415ft., and a moulded breadth of 54ft. 3in., while her deadweight capacity is 9000 tons, including about 700 tons of oil fuel carried in the double bottom. The main propelling machinery is of the twin-screw type, each engine having four cylinders and designed to develop 1350 brake horse-power at a speed of 100 revolutions per minute. With the exception of the absence of the scavenging pumps, the engines are almost identical in design with those installed in the Condé de Churruca, which was described in detail in our issue of September 16th, 1921. The turbo-blowers are two in number and are driven at a speed of about 3000 revolutions per minute by electric motors of 150 brake horse-power running on the ship's circuit of 220 volts. Speed control is provided, and one blower running at a speed of from 2700 to 2800 revolutions per minute supplies sufficient air for both engines. Current is supplied by two 200-kilowatt generators, and the two-stroke cycle engines driving these generators are furnished with extra large air compressors, the surplus air being used to fill the starting air receivers. By this means the auxiliary compressors are eliminated, only a small emergency compressor being necessary. According to a recent cable received from Hong Kong, we are informed that the Handicap has arrived in that port after an uninterrupted run of forty-three days from Panama. The daily fuel consumption averaged 9.8 tons, and we understand that the machinery is in excellent condition.

A Seven-Day Journal.

National Engineering Certificates.

An official pamphlet has just been issued by the Stationery Office in which are set forth the arrangements and conditions governing the award of national certificates and diplomas in engineering under the scheme organised jointly by the Board of Education and the Institution of Mechanical Engineers. The rules are intended for the guidance of technical schools or colleges desirous of submitting schemes of part-time (certificate) or full-time (diploma) courses for the approval of the Board and Institution. The courses of each category are to be divided into senior and advanced classifications, and are to extend over two or more years. The senior courses will be suitable for students over sixteen years of age who have already received junior instruction. The advanced courses will reach the standard of university work. The certificates and diplomas will be awarded on the basis of the number of marks received by the candidates for their home work, class work, laboratory work, and final examinations. The examinations, the papers set and the scrutiny of the results will be under the final control of a Board of Assessors appointed by the Institution.

London's Air Defences.

In continuation of our note in last week's Journal, we can now add that the two anti-aircraft brigades of the Territorial Army to be formed for the defence of London will probably consist of six batteries all told, each having eight 3in. guns mounted on travelling platforms. Each brigade will have allotted to it twenty-four 3-ton lorries for towing guns and six 3-ton lorries for carrying ammunition and stores. In addition to the artillery, the brigades will each include an anti-aircraft battalion of the Royal Engineers, an anti-aircraft squadron of the Royal Air Force, and a section of the Royal Corps of Signals. The Engineers will be responsible for the operation of the searchlights and the sound locators, each company of each battalion being provided with twenty-four 120 cm. searchlights and a like number of sound locators. It will thus be seen that the total equipment for the defence of London, as here indicated, amounts to 48 3in. guns, 60 3-ton lorries, 192 searchlights, 192 sound locators, and 32 aeroplanes. The total *personnel*, excluding the Air Force members, will number about 3000 men.

Clyde Shipbuilders' Offer to Workmen.

It is announced by Lithgows, Limited, shipbuilders, of Port Glasgow, that they are willing to lay down four large cargo steamers if their workmen will accept pre-war rates of wages. The work would find employment for about 2000 men. So far, the offer has not been generally accepted, but it is being carefully considered. Delay in reaching a decision will, it is intimated, lead to the offer being withdrawn, but if it is accepted work on the vessels will be begun at an early date. While the firm's offer has attracted wide interest, it is recognised that its acceptance would neither bind the men to pre-war rates of wages beyond the limit of the work in view nor justify the employers in expecting that such rates are likely to become generally standardised in the near future.

The Co-operation of Engineering Institutions.

As an outcome of the visit of representative American engineers to this country in the summer of 1921, attention was directed to the subject of co-operation between the various engineering institutions, somewhat on the lines of those adopted in the United States. This matter was mentioned in the annual report of the Council of the Institution of Mechanical Engineers, and it was added that in connection with it the Civil Engineers had agreed to call a conference. That conference has now been held, with the result that an Engineering Joint Council has been formed, on which the Civils, Mechanicals, Electricals, and Naval Architects will in the first instance be represented. The Council will aim, not only at promoting closer co-operation between the Institutions, but will endeavour to improve the status of the engineer, to secure the best national use of engineers' services, to prevent unnecessary duplication of activity, and to effect the appointment of properly qualified persons to engineering positions of responsibility.

St. Paul's and Wren.

It has been found necessary by the authorities of St. Paul's Cathedral to issue a statement controverting the rumour that the building was in a dangerous condition, and would have to be closed. To preserve it extensive repairs are necessary, but there does not appear to be any ground for immediate alarm that the dome will fall. Towards the sum of £100,000 for repairs for which an appeal is being made, about £25,000 have now been received. The time is opportune for making an effort to place the condition of the fabric of the building beyond all likelihood of mishap, for we are approaching the bi-centenary of Wren's death. In connection with that event, a "Commemoration Week," beginning on February 26th, 1923, is being arranged by a committee representative of Government Departments, various societies, the universities and other bodies. The events of the week will include a procession from the Mansion House to St. Paul's and an exhibition of Wren's drawings, manuscripts and other architectural, scientific and astronomical relics at the galleries of the Royal Institution of British Architects.

The Aerial Derby.

The results of the annual aeroplane race round London taken over the period from its inception show how remarkably the speed of aircraft has been increased. In 1912 the winning machine, a Bleriot monoplane, with a 70 horse-power Gnome engine, had an average speed of 58.5 miles an hour. Two years later, just before the outbreak of the war, an 80 horse-power machine won with an average speed of 72.15 miles an hour. The developments of the war period are reflected in the fact that on the next occasion, in 1919, the winning machine had a 450 horse-power engine, and revealed a speed of 129.38 miles an hour. In 1920 this speed was easily beaten by a 300 horse-power machine, which flew at 153.45 miles an hour. Last year the Gloucestershire Aircraft Company's 450 horse-power machine, Mars I.—illustrated in our issue of January 6th—developed an average speed of 163.34 miles an hour. On Monday the same machine except for a few minor refinements traversed the 200-mile course at an average speed of 179.5 miles an hour. It is just possible that that speed would have been excelled by the new 400 horse-power Bristol monoplane had it not been prevented by a slight breakage from taking part in the race.

Safety at Sea.

A master mariner in a letter to the editor of a contemporary throws out a number of interesting suggestions for increasing safety of life at sea. He laments the passing of the real able-bodied sailor, and attributes much of the loss of life in recent marine disasters to the fact that such seamen form to-day quite a small percentage of the average passenger ship's complement. With sound philosophy, however, he does not desire us to cast out all those things which have made it possible for us to dispense with the genuine sailor's services. Rather would he have us retain these things, while simplifying and arranging them in such a way as to make their operation rapid and certain in the hands of unskilled passengers and members of the crew. Following out this very logical thesis, he would have us abandon the use of oars as a means of propelling boats, and in their place adopt hand-operated propellers. Launching gear should be standardised so that members of the crew would be familiar with its operation on joining a fresh ship. He recommends the single davit with a single fall, and is in favour of carrying boats for all on each side of the ship. Perhaps the strongest feature in his argument is his contention that by adopting measures on the lines indicated, passengers and crew would be inspired with the confidence that they would be in a position to save themselves in the event of a disaster, and as a result panic—the greatest danger of all in time of stress—would be largely reduced.

Payment by Results.

Something in the nature of a deadlock would appear to have arisen in the negotiations between the engineering employers and the Amalgamated Engineering Union regarding the introduction of a system of payment by results on a national basis. While the boilermakers, patternmakers and foundry workers have reached an agreement in the matter, the conference between the employers and the Amalgamated Union virtually broke down on Thursday of last week, and has not since been resumed. It is understood that the terms offered were such that the average skilled worker would be enabled to earn at least 33⅓ per cent. above his time rate, including the remaining portion of the war bonus.

A Tramway Jubilee.

On the 19th of this month the fiftieth anniversary of the opening of the first section of Glasgow's justly celebrated tramway system will be duly honoured by means of a civic luncheon, reception and dance, and other proceedings, and by the presentation of a sum of £1 to each of the employees in the service. The original lines were laid by the Corporation, but for a period of twenty-three years the right to run cars on them was leased to a private company. In 1894, when this lease expired, the routes covered by the system totalled a length of about 30 miles. To-day, counting extensions now in hand and systems about to be absorbed, the system extends to 150 miles of double track, or practically equal to that controlled by the London County Council. In a short time, one of the routes without change of car will cover 25 miles each way. The competition of omnibuses and suburban railways was long ago easily overcome, and recently the subway—the Glasgow equivalent of a London tube railway—became, after an unprofitable existence of its own, a section of the Tramway Department. On the average, each member of the population of the city uses the cars 322 times per year, and contributes over 35s. to the traffic revenue. Since the system was taken over by the Corporation it has paid off a capital expenditure of more than £4,000,000, and contributed over a million sterling to the Common Good Fund.

The Largest Wireless Station in the World.

Last Sunday night the new French wireless station at Sainte Assise, Melun, began operations by transmitting a message from the French to the American President. The station, when completed, will, it is claimed, be the largest of its kind in the world, excelling in power that at Bordeaux by nearly four times and the Eiffel Tower station by about thirty-five times. It has already reached a transmitting speed of eighty words a minute, but when finished it will, it is hoped, touch one hundred, and be able to send six messages simultaneously, so that altogether it will have a capacity of nearly a million words per twenty-four hours. It is intended to carry all the wireless communication between France and America, but it has already established connection with Argentina and China, and will shortly be in a position to make itself heard all over the world. The station will be worked by means of a long-distance control system from an office in the centre of Paris.

Disinfecting Liners.

Having on two occasions recently called attention to the danger of using hydrocyanic gas for the purpose of disinfecting ocean-going steamers, we think it is only fair to record a smart piece of work which has been carried out with this gas at Liverpool on an Elder Dempster vessel. The order for fumigating the ship was placed at noon, the steamer berthed at 7.30 p.m., and soon after 4 a.m. the next morning the generation of the gas was begun. The fumigation was completed at 11 a.m. the same day, and was carried out to the satisfaction of the port medical authority and of the United States representative, who was present to see that his country's regulations in the matter were complied with. The contractors for the fumigation were the Mining Engineering Company, Limited, of Moorfields, Sheffield, manufacturers of mine rescue and oxygen breathing apparatus. The generation of the gas was carried out under the direction of Watson, Gray and Co., a Liverpool firm of analytical chemists,

Expansion of the Royal Air Force.

The Government's decision, announced last week by the Prime Minister in the House of Commons, to provide a force of 500 aeroplanes for home defence, at an increased cost of £2,000,000 per annum, has been received with pleasure by the aeronautical industry, for it was accompanied by the definite statement that considerable orders for the execution of the programme would be placed with private firms this year. Efforts have been made in some quarters to make a mystery of the matter, for it is obviously impossible, it has been pointed out, to build and equip 500 military aircraft and man them for a year at a cost of two million pounds sterling. It is, we think, fairly clear that it is not intended to realise the complete programme within the space of twelve months, but to spread the building up of the force over a longer period, There is nothing, too, in the statement to imply that all the 500 machines of the force are to be new. On the contrary, the verbatim report of Mr. Lloyd George's statement conveys the distinct impression that a certain number of existing machines—on the active list or in reserve—are included in the five hundred. On the whole, it will probably be found that the number of machines ordered in any one year in fulfilment of the decision will be quite a small fraction of the establishment laid down.

Honour for Professor Coker.

It is announced that the Franklin Institute has awarded the Howard N. Potts gold medal to Professor E. G. Coker in recognition of the work he has done in connection with the photo-elastic method of determining the distribution of stress in structural and machine members. Professor Coker's work in this direction has attracted the greatest interest from naval architects, mechanical engineers and others concerned with stress distribution in metals. His most recent investigations in photo-elasticity have been concerned with the stresses set up in the work and tool in turning, milling and other operations.

Tests of a Camellaird-Fullagar Marine Diesel Engine.

A VERY complete series of tests on a standard four-cylinder 1000 brake horse-power Diesel marine engine has recently been completed by Cammell Laird and Co., Limited, at their Birkenhead Engine Works. These tests, which were carried out over a total running period of about five weeks, were undertaken in order to provide information and data on the following points :—

(1) The endurance and reliability of the engine.

(2) The fuel consumption and the thermo-dynamic conditions in the engine when working under varying conditions.

(3) The ability of the engine to operate under conditions such as are usually found in tropical seas.

(4) The ability of the engine to operate successfully on ordinary boiler fuel oils.

The general arrangement of the engines on the test bed, including the fuel oil weighing tanks and the Froude water brake, which is designed to absorb 3000 horse-power, is shown in Fig. 2, and we were accorded the privilege of inspecting these arrangements during the early part of the trials. The engine tested was the starboard engine No. 2027. A seven days' non-stop endurance trial was run from February 6th to 13th last, and the more important results obtained are given below :—

	Average results.	Results at best fuel consumption.
Revolutions per minute ..	120.3	122.0
Brake horse-power	1023.0	1001.0
Brake M.E.P., lb. per sq. in. ..	62.7	60.5
Working cylinders, mean of M.E.P's.—		
Lower pistons, lb. per sq. in.	100.4	95.65
Upper pistons, lb. per sq. in.	86.4	82.35
Working cylinders, I.H.P. ..	1497.0	1450.0
Mechanical efficiency, per cent.	68.5	69.1
Fuel consumption, lb. per I.H.P. hour	0.273	0.271
Fuel consumption, lb. per B.H.P. hour	0.398	0.392

During this trial the fuel used was Anglo-American Diesel oil having the following characteristics :—Specific gravity, .885 ; flash point, 182 deg. Fah.; gross calorific value, 18,700 B.Th.U. per pound ; and an examination of the engine at the close of the trial showed that the pistons were clean and in good condition. It will be noted that the best fuel consumption over a four hours' period was 0.392 lb. per brake horse-power hour, and this figure, we understand, is slightly in excess of the figure already published and obtained in testing a similar engine ; the difference—0.002 lb.—is, we are informed, explained by the poorer quality of fuel oil used. As the main scantlings of the engine tested were fixed some three years ago, and as since that time the quantities of scavenging air and blast air have been reduced and the design of the combustion chambers improved, there is reason to expect that improved results will be obtained with the later designs.

The trial under tropical conditions consisted of a non-stop run of three days' duration. For this trial the scavenge air intake was connected to the shop heating system and an average air temperature of 102.3 deg. Fah. was maintained throughout the test. The cooling water inlet temperature was also raised and maintained at 91.8 deg. Fah. by by-passing some of the hot water from the jackets into the suction tank. The air compressor suction was also coupled to the scavenging air belt, the temperature of the air entrained being about 140 deg. Fah. Under these conditions the engine ran with perfect reliability. The fuel oil used was similar to that used in Professor Watkinson's trials, referred to below, and the results were as follows :

	Average results.	Results at best fuel consumption.
Revolutions per minute ..	119.4	119.3
Brake horse-power	1050.0	1050.0
Brake M.E.P., lb. per sq. in. ..	64.75	64.8
Working cylinders, mean of M.E.P's.—		
Lower pistons, lb. per sq. in.	99.8	100.5
Working cylinders, I.H.P. ..	1477	1490
Mechanical efficiency, per cent.	71.7	70.5
Fuel consumption, lb. per B.H.P. hour	0.417	0.408

Considerable interest has recently been shown and much has been written concerning the use of boiler oil as a fuel for Diesel-driven vessels, and in order to obtain information as to the performance of the engine when using such a fuel, a seven days' trial was run on Anglo-Mexican boiler oil, which had the following general characteristics :—

Specific gravity at 66 deg. Fah.	.948
Flash point	162 deg. Fah.
Ignition point	238 deg. Fah.
Calorific value	18,860 B.Th.U. per lb. (gross)
Ash	.06 per cent.
Sulphur	2.93 per cent.
Coke	9.5 per cent.
Water	Trace

No alterations were made to the fuel oil pipes on the engine or testing bed arrangements, the oil simply being heated in the daily use tank by the steam coil usually fitted. This arrangement worked quite satisfactorily, although in a ship a light oil tank would be fitted for clearing the heavy oil out of the pipes before stopping the engine. The average results of this trial for the week were as follows :—

Brake horse-power	1000
Revolutions per minute	120
Blast pressure	950 lb. per sq. in.
Scavenging air pressure	1.9 lb. per sq. in.
Lubricating oil pressure	12.7 lb. per sq. in.
Circulating water pressure	13.5 lb. per sq. in.
Exhaust temperature	466 deg. Fah.

The fuel consumption in this case varied from .42 lb. to .44 lb. per brake horse-power per hour. The object of this trial being to find out whether the engine could run economically on boiler oil with average fuel valve settings suitable for a wide range of fuels, no previous alterations or adjustments to the valve gear were made. There is no doubt, however, that with suitable valve settings and other slight modifications the fuel consumptions above given could be considerably reduced, and an engine using such fuels would be adjusted accordingly. The examination of the engine after the trial showed that pistons and cylinders were in satisfactory condition, all the piston rings being free in their grooves. As was to be expected, there was the usual slight carbonisation from the lubricating oil, but careful examination failed to reveal any deposits arising from the fuel oil, and there appears to be no reason why this type of engine should not operate satisfactorily on similar fuel for long periods.

A series of tests made by Professor Watkinson provide very full information, both with regard to the fuel consumption of the engine under different load conditions and also its thermo-dynamic efficiency as a prime mover. Lack of space does not permit us to include all the figures which have been placed at our disposal, but we reproduce in Table I. a summary of the trial results and in Figs. 1, 3 and 4 the indicator cards and the graphical results which accompanied Professor Watkinson's report, of which we give below an abbreviated copy.

Report on the Test of a Four-cylinder 1000 *Brake Horse-power Camellaird-Fullagar Marine Diesel Engine on March* 20*th*, 21*st and* 31*st*, 1922, *by Professor W. H. Watkinson, Liverpool University.*

The engine tested consists of two units combined on one

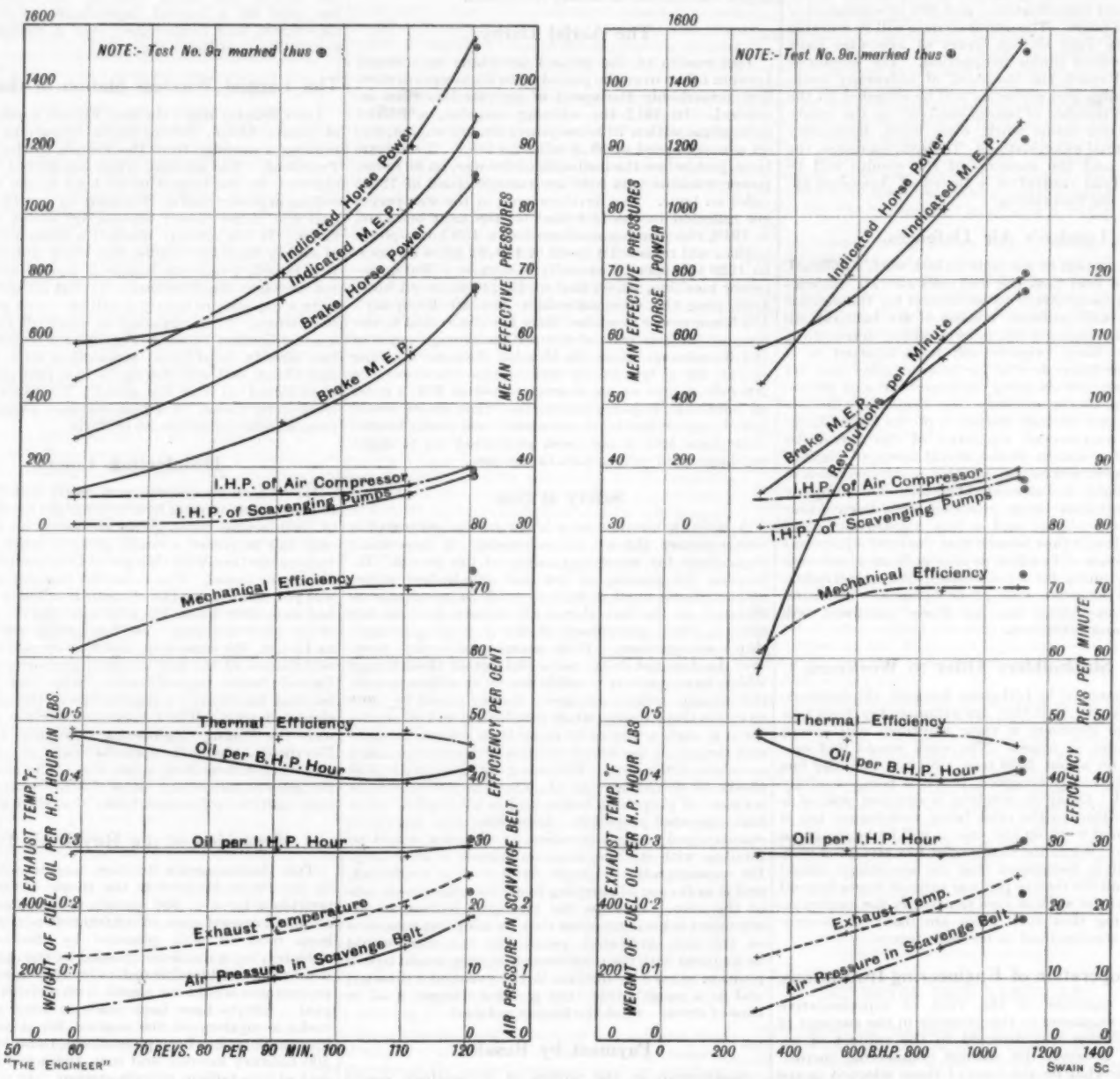


FIG. 1—CURVES SHOWING RESULTS OF PROFESSOR WATKINSON'S TESTS

crank shaft, and each unit of two power cylinders with four power pistons and two scavenge pumps. The distinguishing feature of the engine is that the power pistons are connected by crossed rods which enable the number of cranks per unit to be reduced to two, thus shortening and simplifying the engine, as compared with other opposed-piston engines, and enabling it to run much more steadily owing to the consequent great reduction of the unbalanced inertia forces. The cranks of each unit are inclined to each other at 180 deg., and the cranks of one unit are inclined to the cranks of the other unit at 90 deg. The power pistons are 18½in. in diameter and their stroke is 25in. The scavenge pistons have an area of 921 square inches and a stroke of 25in. All the auxiliaries, including the air compressor, the scavenge pumps and the circulating pumps, are driven by the engine.

FIG. 2—VIEW OF 1000-B.H.P. ENGINE UNDER TEST

The first series of tests were made during a continuous run of 26½ hours on March 20th and 21st, and the second tests were made during a run of eight hours on March 31st. The arrangements made prior to the tests for obtaining all possible data regarding the operation of the engine were more complete than have ever been previously attempted in connection with an oil engine of so great a power as this, and, in spite of some difficulties, these arrangements proved satisfactory. In addition to the measurements usually made for testing an engine of this power, measurements were made of the rates of flow of the following:—(1) The cooling water through the jackets of the power cylinders; (2) the cooling water through the jackets, intercoolers and after cooler of the air compressor; (3) the water through the oil cooler; (4) the cooling oil for the power pistons; (5) the lubricating oil for the bearings; (6) the air to the scavenge pumps. In all these cases the circular orifice method, with tanks and stilling arrangements, was adopted. For the measurements of the pressure difference on the two sides of the air measuring orifice a water column gauge was used, and for the measurement of the pressure of the air in the scavenge belt a mercury column gauge was used.

Each set of indicator diagrams consists of fifteen cards and all these were taken as nearly as possible at the same instant; but it was, of course, impossible to take the diagrams for the top and bottom pistons at the same time. All the indicators and thermometers used during the tests were tested in my laboratory at the University and the readings taken during the tests of the engine were corrected, where necessary, in accordance with the calibrations of the instruments. The fuel oil was weighed continuously on two weighing machines, and I tested the machines by means of standard weights and found that they were correct. Samples of the fuel oil were taken during the tests, and these were afterwards tested in a bomb calorimeter and in other ways, with the following results:—

Oil Used in Tests.

	Nos. 1 to 8.	Nos. 9 and 9a.
Calorific value (lower), B.Th.U.	18,090	18,260
Specific gravity at 59 deg. Fah.	0.878	0.880
Flash point	181 deg. Fah.	185 deg. Fah.
Viscosity at 62 deg. Fah.	55 sec.	61 sec.

The calorific value of the sample taken for tests 9 and 9a was 0.9 per cent. greater than that of the samples collected for the other tests, and it had a slightly higher density, flash point and viscosity.

I have calculated the value of n in the equation $P V^n = C$ from cards taken from the power cylinders during test No. 9 with the following results, which are the means for four cards taken from each cylinder:—

Value of n.

No. of cylinder.	Compression.	Expansion.
1	1.396	1.167
2	1.371	1.207
3	1.344	1.183
4	1.378	1.244

I have divided the test made on March 31st into two, No. 9 and No. 9a, because the engine did not give as good results during the first four hours as it did during the last three hours. I was informed at the time that this was probably due to boiler oil having been used in the engine on the previous day. I obtained for test 9a the following results, the percentages being based on the heat due to the fuel oil used per minute:—

Heat due to oil used per minute = 145,800 B.Th.U.

	B.Th.U.	Per cent
Heat equivalent of indicated work per minute	67,430	44.4
Heat carried away by jacket water per minute	30,630	21.0
Heat carried away by piston cooling oil per minute	5,230	3.6
Heat carried away to exhaust	36,200	24.8
Heat lost by radiation, &c. (by difference)	9,010	6.2
	145,800	100.0

From which it will be seen that the brake thermal efficiency is 32.7 per cent.

A set of indicator diagrams is reproduced in Fig. 3, while various curves giving the results of the tests made in accordance with the propeller law are reproduced in Fig. 1, and on the same sheet the results are given on a brake horse-power base. The distribution of the heat in the engine is shown graphically in two different ways in Fig. 4.

The weight of the fuel oil used per brake horse-power hour in my tests (1) and (2) is approximately the same as that given in the paper read by Mr. James Richardson before the Institution of Naval Architects in April of this year for the Beardmore-Tosi engine of the motor ship Pinzon. This engine is of the four-stroke cycle type, with six cylinders, and its nominal power is 25 per cent. greater than the normal power of your engine. During the whole

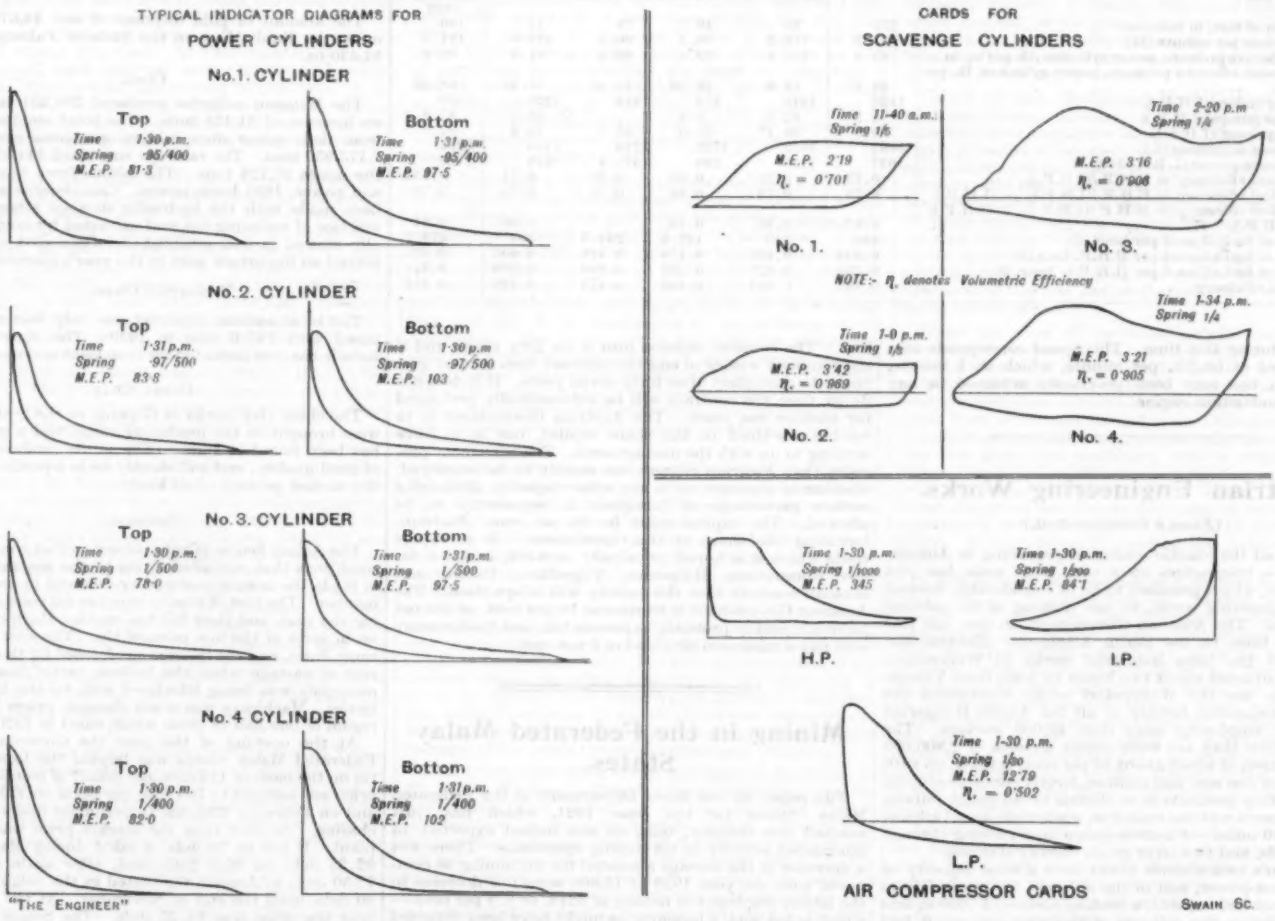


FIG. 3—REDUCED SIZED INDICATOR CARDS FROM POWER AND SCAVENGE CYLINDERS AND AIR COMPRESSOR

of my tests the engine worked as smoothly and as noiselessly as any marine steam engine, the amount of attention required for its operation was almost negligibly small, the exhaust gases were absolutely invisible during most of the tests, and in no case were they more than barely visible. The amount of lubricating oil used for the engine pistons was remarkably small, being only 0.164 gallons per hour when the engine was giving 1115 brake horse-power. This is equivalent to 0.147 gallon per hour per 1000 brake horse-power, or to approximately 7000 brake horse-power hours per gallon.

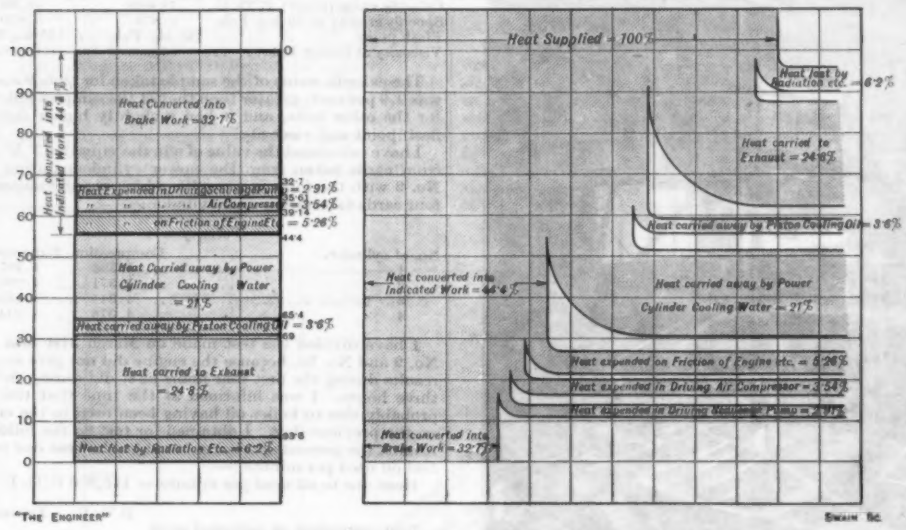

Heat Converted into Brake Work = 32·7%
Heat carried to Exhaust = 24·8%
Heat carried away by Power Cylinder Cooling Water = 21%
Heat carried away by Piston Cooling Oil = 3·6%
Heat lost by Radiation Etc. = 6·2%
Heat converted into Indicated Work = 44·6%
Heat Supplied = 100%
Heat expended on Friction of Engine Etc. = 5·26%
Heat expended in Driving Air Compressor = 3·54%
Heat converted into Brake Work = 32·7%
"THE ENGINEER"
SWAIN Sc.

FIG. 4—DIAGRAMS SHOWING HEAT DISTRIBUTION IN TEST 9a

At the conclusion of my tests a series of manœuvring trials were made, and the time for reversal from full speed ahead was 2½ sec., firing in the cylinders began 2½ sec. later, and the engine was running full speed astern in 8 sec. from the instant that I gave the signal to reverse. The engine was run for some time at a speed of 16½ revolutions per minute, firing taking place regularly in all cylinders during this time. This speed corresponds to a piston speed of 68.7ft. per minute, which is, I believe, lower than has ever been previously achieved in any internal combustion engine.

TABLE I.—*Summary of Powers, Consumptions and Efficiencies.*

	Test number.					
	1.	4.	5.	6.	7.	9a.
1. Date of test	March 20th and March 21st, 1922.					March 31st, 1922.
2. Duration of test, in minutes	375	36	49	28	19	180
3. Revolutions per minute (R)	117.3	118.3	58.5	90.5	110.6	121.1
4. Mean effective pressure, power cylinders, lb. per sq. in.	89.0	102.4	59.5	66.6	81.5	92.8
5. Brake mean effective pressure, power cylinders, lb. per sq. in.	64.97	76.8	36.29	46.62	57.86	68.48
6. Power cylinders (I.H.P.)$_p$	1420	1648	473	818	1220	1526
7. Scavenge pumps (I.H.P.)$_s$	78.2	82.5	9.8	—	59.5	87.6
8. Air compressor (I.H.P.)$_c$	90.9	88.1	51.3	60.7	70.8	97.2
9. Brake load in pounds (L)	3093	3653	1722	2210	2753	3254
10. Brake horse-power (L R ÷ 350)	1037	1235	288	571.4	870	1126
11. Mechanical efficiency = B.H.P./(I.H.P.)$_p$	0.73	0.75	0.61	0.70	0.71	0.738
12. Mechanical efficiency = B.H.P./(I.H.P.)$_p$ – (I.H.P.)$_s$	0.78	0.79	0.68	0.75	0.76	0.79
13. Mechanical efficiency = B.H.P./(I.H.P.)$_p$ – (I.H.P.)$_s$ – (I.H.P.)$_c$	0.83	0.83	0.70	—	0.80	0.84
14. Weight of fuel oil used per hour, lb.	434	540	137.8	244.3	354	479.2
15. Weight of fuel oil used per B.H.P. hour, lb.	0.418	0.435	0.478	0.428	0.407	0.425
16. Weight of fuel oil used per (I.H.P.)$_p$ hour, lb.	0.305	0.327	0.290	0.298	0.290	0.314
17. Thermal efficiency	0.462	0.431	0.486	0.473	0.486	0.444

Austrian Engineering Works.

(*From a Correspondent.*)

AMIDST all the chaotic confusion prevailing in Austria-Hungary, a transaction on a very large scale has just taken place, which promises to be of considerable interest to the engineering world, to say nothing of its political importance. The Austrian Government, in fact, has just agreed to lease to the Berlin Allgemeine Elektrizitätsgesellschaft the large industrial works in Wöllersdorf, which are situated about two hours by train from Vienna. During the war the Wöllersdorf works constituted the largest ammunition factory in all the Austro-Hungarian monarchy, employing more than 40,000 workers. The site on which they are built covers an area of 2,800,000 square metres, of which about 15 per cent. is taken up with buildings of one sort and another, largely concrete edifices. In the factory precincts is an electric broad-gauge railway which connects with the main line, while there are 64 kiloms. —nearly 40 miles—of narrow-gauge lines running through the grounds, and two large goods railway stations.

The firm's own electric works have a total capacity of 40,000 horse-power, and in the different factory buildings are 28 steam boilers, with a heating surface of 7000 square metres. Before the collapse of this vast concern it had been partly reconstructed, so as to serve for peace work, and it therefore possesses workshops for producing metal goods, tools, machinery and spiral springs; repair shops for railway trucks and coaches, and even glass works. The Allgemeine Elektrizitätsgesellschaft is, it is stated, going to form a limited company with a preliminary capital of 1,000,000,000 kronen to acquire the undertaking.

Since the Armistice the works have been employing only about four thousand workers. They have, of course, been run by the Government, and, as might be expected, carried on at such a loss that of late there have been monthly deficits of 400,000,000 to nearly 500,000,000 kronen, and that despite the fact that there was a very considerable amount of usable material left over after the war. It is anticipated that when the Allgemeine Elektrizitätsgesellschaft has everything in good working order at least 30,000 people may be employed.

Despite the woeful financial condition, both of the Wöllersdorf works and of Austria, there has been some competition to acquire the former. British, Dutch, and even Swedish engineering firms made offers for them, but the Allgemeine Elektrizitätsgesellschaft gave the best terms. The Austrian Government did its utmost to induce Austrian engineering firms to take over the Wöllersdorf works and run them privately, on business lines, but no Austrian company would face the task. Consequently the Government had to close with the offer of the Berlin firm. The contract entered into is for fifty years, and if the company wishes to end the contract then it must give notice to that effect after forty-seven years. If it does not do so, then the contract will be automatically prolonged for another ten years. The Austrian Government is to receive one-third of the share capital, but is to have nothing to do with the management. The agreement provides that Austrian citizens are mainly to be employed, whether as workmen or in any other capacity, although a certain percentage of foreigners is apparently to be allowed. The capital must be 60 per cent. Austrian, including the share of the Government. It is export trade which it is hoped principally to work, and it is for the Roumanian, Bulgarian, Yugo-Slav, Polish, and Russian markets that the factory will adapt itself. The Austrian Government is to receive 10 per cent. of the net profits, in reality probably as income tax, and the company is to pay a minimum dividend of 6 per cent.

Mining in the Federated Malay States.

THE report of the Mines Department of the Federated Malay States for the year 1921, which has just reached this country, tells, as was indeed expected, of diminished activity in tin-mining operations. There was a decrease in the acreage alienated for tin mining as compared with the year 1920 of 15,800 acres; a decrease in the labour employed in mining of 3218, or 3.7 per cent.—which is not such a lessening as might have been expected—and a decrease of 5160 horse-power in machinery and hydraulic appliances. There was, too, a considerable decrease in the number of licences taken out by ore buyers. The result of the year's working was that the amount of tin exported was 34,490 tons in 1921, as compared with 34,935 tons in 1920, a decrease of only 445 tons. It is reasonable to expect that if low prices for the metal should continue for much longer the output will be more seriously affected, but the fact that a drop in the average price of the metal from over £297 a ton in 1920 to £168 a ton in 1921 resulted in a diminution of the exports by less than 500 tons is rather remarkable. The explanation is that the Chinese mining labourer has simply adapted himself to the circumstances. About 13,000 labourers were discharged from the larger mines, but they were absorbed elsewhere. Wages fell considerably, and in many cases labourers worked for their board alone. There was a decrease in contract labour of 30.7 per cent., and an increase in tribute labour of 49.86 per cent. compared with 1920. This is the explanation of the maintenance of the output of tin in Malaya, and it indicates the stoicism of the Chinese mining labourer, and, after the experience that Malaya has gone through during the last two years, fears which were felt by some as to the probability of serious trouble among the Chinese miners may, it is considered, be set at rest.

The States rely to a considerable extent on tin for their revenue, which has suffered very seriously. Export duty on tin realised only 6,153,360 dols., as compared with 12,203,531 dols. in 1920. The total revenue from mining amounted to 6,688,105 dols.

The necessity for dealing with the accumulated tailings has been forced upon the Government owing to the silting of the rivers and consequent risk of floods. Orders have been issued for the stoppage of sluicing operations where tailings cannot be controlled. This may entail the closing of a considerable number of small mines. The methods of mining in the Federated Malay States may be compared by showing the number of labourers employed in each class of mining. The total number of labourers employed at the end of the year was 86,338. This does not include the holders of "dulang" (pan) passes, who numbered 13,418, mostly women. The labourers were distributed as follows:

Open-cast and surface	40,699
Underground	10,058
Hydraulic and lampan	29,973
Bucket dredging	5,608

Of the total labour force 80,110 were Chinese, 3525 Indians, 2307 Malays, 327 Europeans, and 70 others. Thirty bucket dredgers were in operation, and twenty-two more were proposed or under construction.

It is interesting to note the variation in the proportion of output from European-managed mines in late years as compared with the output from Chinese mines.

	European.	Chinese.
1913	26	74
1919	32	68
1920	36	64
1921	39.2	60.8

Improved methods of mining will without doubt result in the saving of a considerable quantity of tin. Gravel pumps and bucket dredgers are very popular, and mining by the old-fashioned methods is practically dead, except in the case of lampanning, which is being discouraged. The proportion of the total output won from lode mining was 5.6 per cent. as compared with 9.6 in 1920. Bucket dredgers accounted for 13.5 per cent.

GOLD.

The amount of gold disposed of was 14,674 oz. One mine, the Raub Mine, in the State of Pahang, produced 14,430 oz.

COAL.

The Malayan collieries produced 299,351 tons of coal, an increase of 51,434 tons. The total amount produced from their mines since mining operations commenced is 1,175,950 tons. The railways consumed 144,934 tons and the mines 92,728 tons. The labour force was 2700 men, and power, 1891 horse-power. Considerable advance has been made with the hydraulic stowage scheme and the practice of replacing the coal extracted by sand hydraulically stowed is well established. Open-cast working has played an important part in the year's operations.

TUNGSTEN ORES.

The total amount exported was only 55 tons, as compared with 233.6 tons in 1920. This figure does not include the ores imported for treatment and re-exported.

CHINA CLAY.

The china clay works at Gopeng, in the State of Perak, were brought to the producing stage, and a good market has been found in India. The works produce fire-bricks of good quality, and will shortly be in a position to put on the market pottery of all kinds.

GENERAL.

The Acting Senior Warden observes that considering the conditions that prevailed owing to the general depression in trade the mining community behaved in an exemplary manner. The cost of mining supplies fell considerably during the year, and their fall has enabled the miner to carry on in spite of the low price of tin. The cost of firewood came down, and the fall was accelerated by the drop in the cost of cartage when the bullock carter found that his monopoly was being interfered with by the use of motor lorries. Machinery was much cheaper, prices being in the region of one-half of those which ruled in 1920.

At the opening of the year the Government of the Federated Malay States was buying the local output of tin on the basis of 115 dols. per pikul* of metallic tin. The price was reduced to 100 dols. per pikul on February 15th, and on February 27th the Government discontinued purchasing. At that time the market price was 84 dols. a pikul. It fell to 72 dols. a pikul during March, rose to 92.25 dols. on May 25th, and, after again dropping to 72.50 dols. in August, fluctuated in the neighbourhood of 80 dols. until the end of November. At the close of the year the price was 85.25 dols. The Senior Warden of Mines observes that the action of the Government in buying tin before Chinese New Year no doubt saved a number of miners and helped tide over that period. The effect of the falling price on the miner has been the same as that on the planter. It has opened his eyes to the many ways in which his business can be carried on at a much lower cost than he was aware of.

* 1 pikul = 133 lb.

Railway Matters.

The American Electric Railway Association, which comprises nearly 600 railway and manufacturing companies, will hold its forty-first annual convention in Chicago from October 2nd to October 6th, simultaneously with the conventions of its subsidiary organisations, the Engineering, Transportation, Manufacturers, Accountants and Claims Associations.

A report from Stockholm says that, after tests extending over ten years, the Swedish State Railway Board has ordered from the Skandinaviska Kullagerfabriken 1360 ball-bearing boxes for use on 140 wagons. The tests showed that the ball-bearing system possessed great advantages as regards safety in working, saving of power, economy in lubricants, and reduced supervision.

By the London Electric Railways (Fares, &c.) Act, 1920, the Underground Companies received exceptional treatment as compared with other railway companies. The Ministry of Transport was, however, given certain powers in the matter, and under these the Rates Advisory Committee has now, announced Mr. Neal on the 27th ultimo, been requested to advise as to what, if any, modifications should be made in the fares now in operation.

As a preliminary to amalgamation in the Southern Group it has been thought desirable that the three interests (1) South-Eastern Railway Company, (2) London, Chatham and Dover Railway Company, (3) South-Eastern and Chatham Joint Managing Committee should first be amalgamated into a South-Eastern and Chatham Railway Company. The Chatham proprietors were not unanimous as to this, and the scheme was carried on the 4th instant in the face of much opposition.

Though no official decision has been announced, it would appear certain that work in connection with the Sydney city railway (a portion of which will travel underground) will be proceeded with. Reports prepared show that nearly £1,000,000 has been spent already on the project. The Ministry of Railways has stated :—"The City Railway must be proceeded with and brought to completion at the earliest date possible. Traffic is increasing at the rate of 10 to 12 per cent. per annum, and the present tracks are at the limit of their capacity."

A new foundry, to cost £200,000, is being erected by the Victorian Railways Commissioners at their workshops at Newport, outside Melbourne. The structure, which will be of corrugated iron and iron girders, will cover 60,000 square feet. Electric cranes will be installed for the transfer of molten metal in the building, in which 250 men will be employed. The 350 ampère-hour electric storage battery, with accessories and spares, for which tenders have been called, is to consist of sixty-four cells connected in series, or alternatively, four in series and sixteen in parallel.

In order to meet the increasing traffic and the development of the Kailan coal mines, the output capacity of which has been raised to 15,000 tons of coal per day, the Peking-Mukden Railway is doubling the track between Tangshan and Chinwangtao and carrying it as far as Shanhaikwan. This important work will, it is said, be completed during this year. At Chinwangtao the yards have been enlarged, and are now capable of handling 15,000 tons of coal per day and storing 260,000 tons. There are now thirteen locomotives, four new engines having been added, and twenty coal cars, built in the Kailan Mining Administration workshops, have also been added to the local rolling stock.

According to the Board of Trade returns, the value of the railway material exported during the first five months of the present year was as follows, the corresponding figures for 1921 and 1920 being added in brackets :—Locomotives, £2,841,317 (£3,109,568, £1,862,418); rails, £1,418,337 (£1,765,102, £733,072); carriages, £817.573 (£668,093, £607,898); wagons, £1,926,718 (£2,682,351, £2,414,439); wheels and axles, £706,396 (£985,950, £815,008); tires and axles, £229,110 (£696,948, £527,199); chairs and metal sleepers, £1,089,417 (£714,264, £283,622); miscellaneous permanent way, £745,802 (£1,319,464, £953,262); total permanent way, £4,288,251 (£5,613,725, £3,343,642). The weight of the rails exported was 136,404 tons (80,146 tons, 40,835 tons), and of the chairs and metal sleepers 79,572 tons (29,008 tons, 13,556 tons).

The rector of Tooting addressed a letter to *The Times* the other day complaining that there was no railway communication in Tooting. Before the war this London suburb was served by a London and South-Western service between Ludgate-hill and Wimbledon, which ran over the South-Eastern and Chatham, the London, Brighton and South Coast and the London, Brighton and South Coast and London and South-Western Joint railways, but not over a single rail of its own property. Approaching Wimbledon, it ran over one side of a triangle, the base of which was the Brighton Company's line between Streatham Junction and Mitcham Junction, and the other side of which was the Brighton Company's single line from Mitcham Junction through Mitcham to Haydon's-road Station, Wimbledon. An extension of the City and South London to Tooting and Southfields has often been suggested.

Asked a question as to whether the Ministry of Transport had any control over the Irish railways, Mr. Arthur Neal replied that by virtue of the Provisional Government (Transfer of Functions) Order, 1922, made under the Irish Free State (Agreement) Act, 1922, the functions of the Ministry of Transport in connection with the administration of railways in Southern Ireland were transferred to and became exercisable by the Ministry of Economic Affairs of the Provisional Government as from April 1st last. The Minister of Transport, therefore, no longer exercises such functions in Southern Ireland, but no transfer of his functions in relation to railways in Northern Ireland has yet been made in view of the provisions of the Government of Ireland Act, 1920, and the Provisional Government (Council of Ireland) Order, 1922, and the fact that the appointed day with respect to the powers of the Council of Ireland has not yet been fixed. Mr. Neal added, in reply to an inquiry as to the present condition of Irish railways, that he was not in possession of any detailed survey of the present condition of the railways in Ireland.

Notes and Memoranda.

The extensive use of pulverised coal for fuel in industrial plants gives interest to tests recently made by the United States Bureau of Mines, which proved that coal dust suspended in air can be exploded by electric arcs under conditions that might prevail in a pulverised coal plant or in a coal mine.

It is reported that a machine has been produced which is capable of drying a photographic print in four minutes. The drying is done by means of an electrically heated absorbent "blanket," and at the end of four minutes the print is automatically ejected, perfectly dry and uncurled, into a tray. While it takes four minutes to dry a single print the machine can take a batch at a time. By being continually "fed," more than 3000 prints an hour can, it is said, be perfectly dried.

Accidents in coal mines in the United States during June, the third month of the strike, resulted in the loss of ninety-two lives. Revised figures covering the present strike period show seventy-eight fatalities in April and seventy-nine in May. The increased number of accidents in June as compared with May was confined largely to the bituminous mines of Pennsylvania and West Virginia. Based upon a production of 22,393,000 tons of coal in June, the fatality rate for the month was 4.11, as compared with 3.89 for May, 4.94 for April of the present year, and 4.03 for June, 1921.

The proposed scheme for the utilisation of the Humber River, Newfoundland, for the production of electric power, is said to be one of the least costly yet built considering the possible output. It is estimated that 235,000 horse-power can be obtained at the head of Deer Lake for an expenditure of some £20 per kilowatt. Much of the electrical power which will be generated in connection with the Deer Lake scheme is to be transmitted the 75 miles between the site of the plant and the great copper areas of Notre Dame Bay, where it will be employed for smelting purposes. Newfoundland will then, it is said, be in a position to compete with any copper-producing country in the world.

Dr. Koppers, in the April 13th, 1922, issue of *Stahl und Eisen*, points out that in American practice 1 ton of pig iron can be produced with 527 kilos. (10.37 cwt.) of carbon, with less highly heated blast that is used in Europe. The blast-furnace, he remarks, generally suffers from too high a temperature in the shaft, and he recommends his own practice, viz., drawing off some of the gases between the bosh and the shaft. He contends that coke, exceeding a temperature varying between 600 deg. and 800 deg., according to the variety of coal, becomes more difficult to burn. Tests showed that the specific gravity of a certain coke, upon heating from 700 deg. to 950 deg., actually rose by almost 20 per cent.

Some experiments carried out in Illinois on the curing of concrete road surfaces with calcium chloride have shown that the beneficial effect of the chemical occurs chiefly within the first twenty-four hours. The actual curing of concrete pavements with calcium chloride was tried with favourable results in a few cases during the last construction season. In one case 7 miles of pavement were cured by first covering the pavement with about an inch of earth and then sprinkling the earth covering with a rich solution of calcium chloride, applied so as to ensure approximately 4 lb. of the chemical per square yard of surface. The earth covering was felt to be necessary to hold the solution on the surface of the road and to prevent loss in case of a heavy rain.

An important point which has been receiving a good deal of attention during the past year is that of the most economic voltage to use for operating the motors driving the auxiliary machinery on board ship. On land some voltage of the order of 440 or 500 volts has become almost standardised for power purposes. On board ship no such definite choice has yet been made nor can be made. The point has been dealt with at some length by Mr. C. H. Wordingham and Mr. S. E. Glendening in the columns of the *Electrician*. The latter, while realising the advantages obtainable by the employment of the pressures usual in land practice, has pointed out that at higher pressures than 220 volts surface leakage becomes an important matter, flashovers increase considerably in number and importance, and corrosion requires that special methods of construction shall be used.

According to a message from Vienna to the *Berliner Tageblatt*, extensive layers of mica were discovered last year in Styria and Carinthia. Experiments have shown that the mineral is well adapted for electro-technical purposes, and mica from the Styrian fields has already found practical use. In Carinthia a company has been engaged in the extraction of mica for some time. For the exploitation of the Köflach fields a company with headquarters at Graz, the Oesterreichische Glimmerwerk G.m.b.H., has been formed. The new company is taking over the working of a part of the Carinthian mica fields as well as the Köflach beds. The keen interest taken by the German electro-technical industry in the discovery is shown by the fact that Herr Walter Zörnig, of Eisleben, who worked for years on behalf of German companies in East African mica mines, has been appointed mining manager of the newly formed Austrian mica company.

For a long time some doubt has existed, according to Mr. H. A. N. Bluett, British Commercial Agent for the Netherlands East Indies, as to the ability of British car builders to compete in that market. However, it has now become quite clear that British cars will sell and sell well in those Islands if manufacturers will adopt the most important means possible for success, i.e., establish their own selling organisations locally and give up at once the idea that successful business can always be done through agents. This contention has recently been proved by the proprietors of a well-known British make, whose representative arrived when the trade slump was at its worst, and when even American cars were unsaleable. By admirable local organisation, and because the company concerned was prepared to alter the design of its cars to suit the requirements of the native population, this British-made car is now selling well, in spite of the fact that it is more expensive than an American car of a similar standard.

Miscellanea.

The pier which the Canadian Pacific Railway is about to build at Vancouver for the accommodation of its ocean liners will be 850ft. long by 330ft. wide, and is to be completed by September of 1923.

The value of the recent batch of Russian orders which were placed in Sheffield and the Midlands is said to be round about £200,000. The goods, which were mainly files, wood saws, screwing tackle, scythes, sickles, and a few other kinds of tools, have been shipped to Siberia, and further orders for shipment to the Baltic ports are expected shortly.

The proposed visit to China of Mr. F. Palmer, consulting engineer to the Port of London Authority, to make a survey of the Yangtze with a view to reporting on it for the purposes of a conservancy scheme, has been postponed till 1923 so as to allow of the collection of essential data by a Committee which is to consist of four Chinese and three foreigners.

The William Penn, a 12,375 deadweight ton Diesel-driven freighter, left Savannah on September 10th last with a miscellaneous cargo of 10,000 tons for Japan and made a voyage of some 30,000 miles round the world. The expenditure of fuel was only 13¼ tons of fuel oil per day when steaming at a regular speed of a little over eleven knots. The *personnel* was a little more than two-thirds of what she would have carried had she been under steam.

The June production of motor vehicles in the United States was slightly in excess of 288,000 cars, including both passenger vehicles and trucks. This establishes a new high record for motor car production in the American industry, being 12 per cent. higher than the May production of 256,000 cars. It is estimated that the figures indicate a total production for 1922 of more than 2,000,000 motor vehicles. During the second quarter of the year 763,000 motor cars were manufactured, while the total for the first six months was 1,137,000.

The City Coroner's inquiry on the recent fire at the Metropolitan Railway Moor-lane sub-station ended with a verdict that the fire originated by the breakdown of a transformer, that its spread was due to the absence of sand or other fire-extinguishing appliances, and that the fire brigade should have been called much earlier. The reluctance of sub-station attendants to call the fire brigade, which they know will mean the virtual flooding of the place, and putting it completely out of action, is comprehensible; but it seems to have been overdone in this case, when forty-five minutes were spent in efforts to conquer the fire.

A new steel bridge, 480ft. in length, erected over the river Matagente, traversing the valley of Chincha, in Peru, has been completed and is now open to traffic. The completion of this work will facilitate the transportation of the large quantities of cotton grown upon the estates of San Regio, San José, Hoja Redonda, Tambo de Mora, and Chincha Alta. Up till now the factories have been considerably impeded in dealing with their output; during nearly one-half of the year they were completely isolated owing to the impossibility of traversing the only cart road between Chincha and Pisco, on which many fatal accidents occurred to the native carters.

On the 3rd inst., Mather and Platt, Limited, gave, at the Holborn Cinema Theatre, a private exhibition of an American film production entitled "The Menace." This film is intended to lay stress on the efficiency of automatic sprinkler control in dealing with outbreaks of fire. It contrasts vividly the time-honoured method of the use of the hose from the exterior of the burning building, the delay, the panic and stampeding of the inmates, and all the accompanying horrors, with the effect of the automatic action of the sprinkler, which operates very quickly after the outbreak of fire by spraying water on to and in the neighbourhood of the fire, and at the same time automatically raises the fire alarm.

With the view of encouraging local industries, the Brazilian Government has afforded special facilities for the importation of machinery for dealing with chemical pulp into the State of Sao Paulo, where it is proposed to erect the first plant in South America capable of producing paper from straw and Paraná pine. Newsprint has been manufactured hitherto, but has proved of inferior quality. The new plant and machinery will be required by the Companhia Fabril de Cubatao and the Companhia Industrias Brazileiras de Papel, at Sao Paulo, Brazil. The latter enterprise has already one plant at work, the daily capacity of which is between 12 and 13 metric tons of paper. It is proposed to increase this output by 50 per cent.

A new motor high road across Honduras from ocean to ocean will, it is announced, be finished within three months. It runs from San Lorenzo, on the Pacific, to Tegucigalpa, 130 miles; then to Comayagua, 103 miles; then to Siguatepeque, 40 miles; then to Lake Yojoa, 42 miles; then to Potrerillos, 50 miles. Work is also in progress on another high road to unite San Pedro Sula, an important town on the Atlantic coast, with the territory bordering on the Salvador frontier, a distance of about 300 miles. Several other roads for motor traffic in the interior also have been started. As there are no railways in the country except on the Atlantic littoral, all traffic is now changing from the old-fashioned ox-carts to motor cars and trucks.

According to a Government report on the economic and financial situation of Egypt, motor transport of all kinds, particularly in the form of taxicabs and commercial motor vehicles, received a tremendous fillip in 1921 as the result of public appreciation of a cheaper and quicker means of locomotion than the slow and dingy horse cabs in charge of surly and rapacious drivers. Five regular omnibuses and 234 taxicabs are now running in Alexandria in addition to 1137 private motor cars and 359 motor cycles; while commercial motor vehicles consist of 69 heavy lorries and 35 light motor vans. In Cairo 308 taxicabs, 79 motor omnibuses (used by schools, hotels, &c.), and a few others plying for hire, are running; private motor cars number 1944 and motor cycles 930; while there are 110 motor lorries used by business firms, works, and other establishments.

THE RECONSTRUCTION OF PLANTATION QUAY IN GLASGOW HARBOUR

SIR WILLIAM ARROL AND CO., LIMITED, GLASGOW, ENGINEERS

(*For description see page* 137)

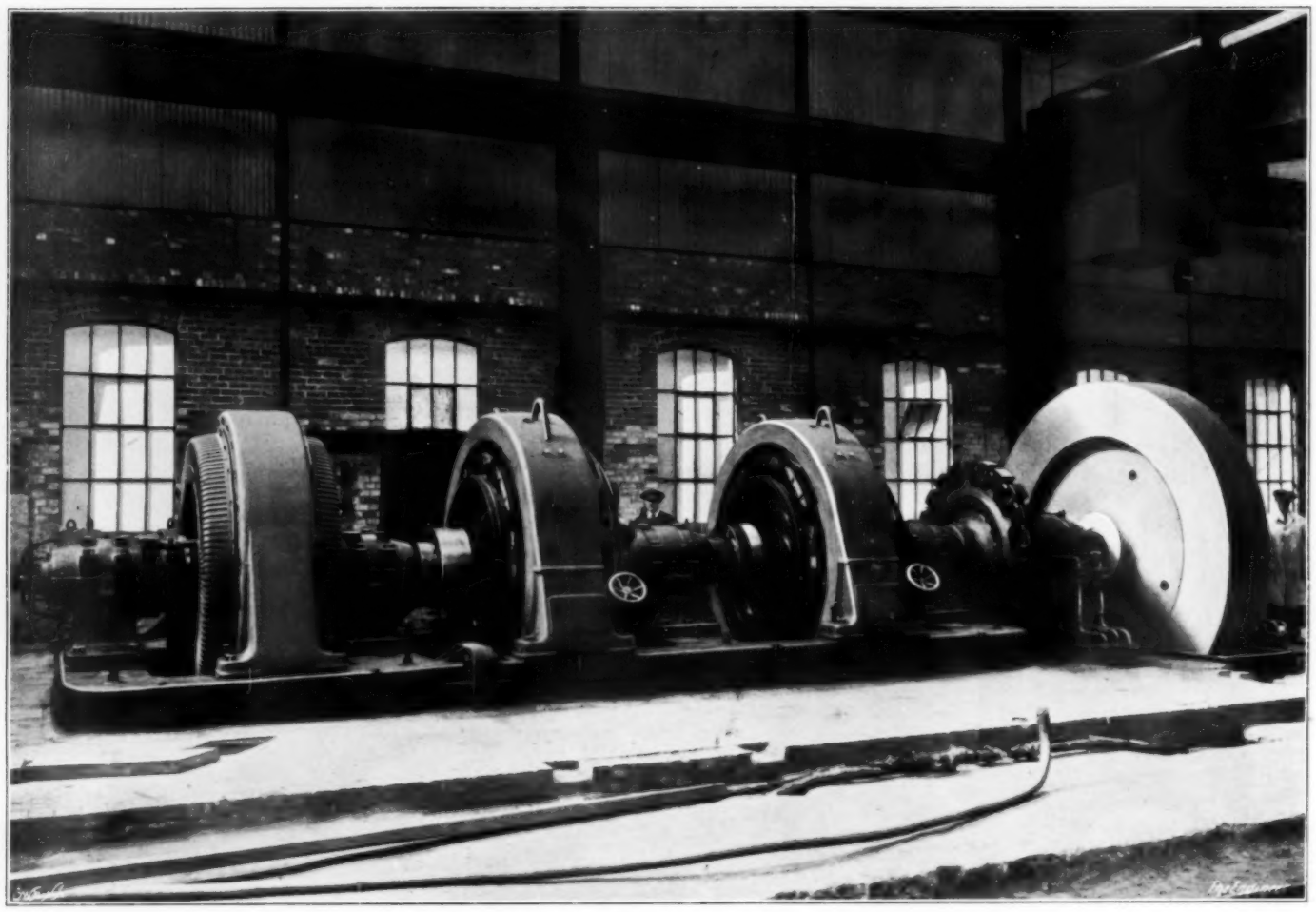
VIEW IN WORKING CHAMBER OF CAISSON UNDER RIVER BED

VIEW LOOKING EAST SHOWING POINT OF FRACTURE OF OLD WALL

SIX AIRLOCKS IN OPERATION ON TWO CAISSONS

GENERAL VIEW SHOWING DECK STAGING

ELECTRICALLY-DRIVEN 28-INCH ROLLING MILL AT THE EAS



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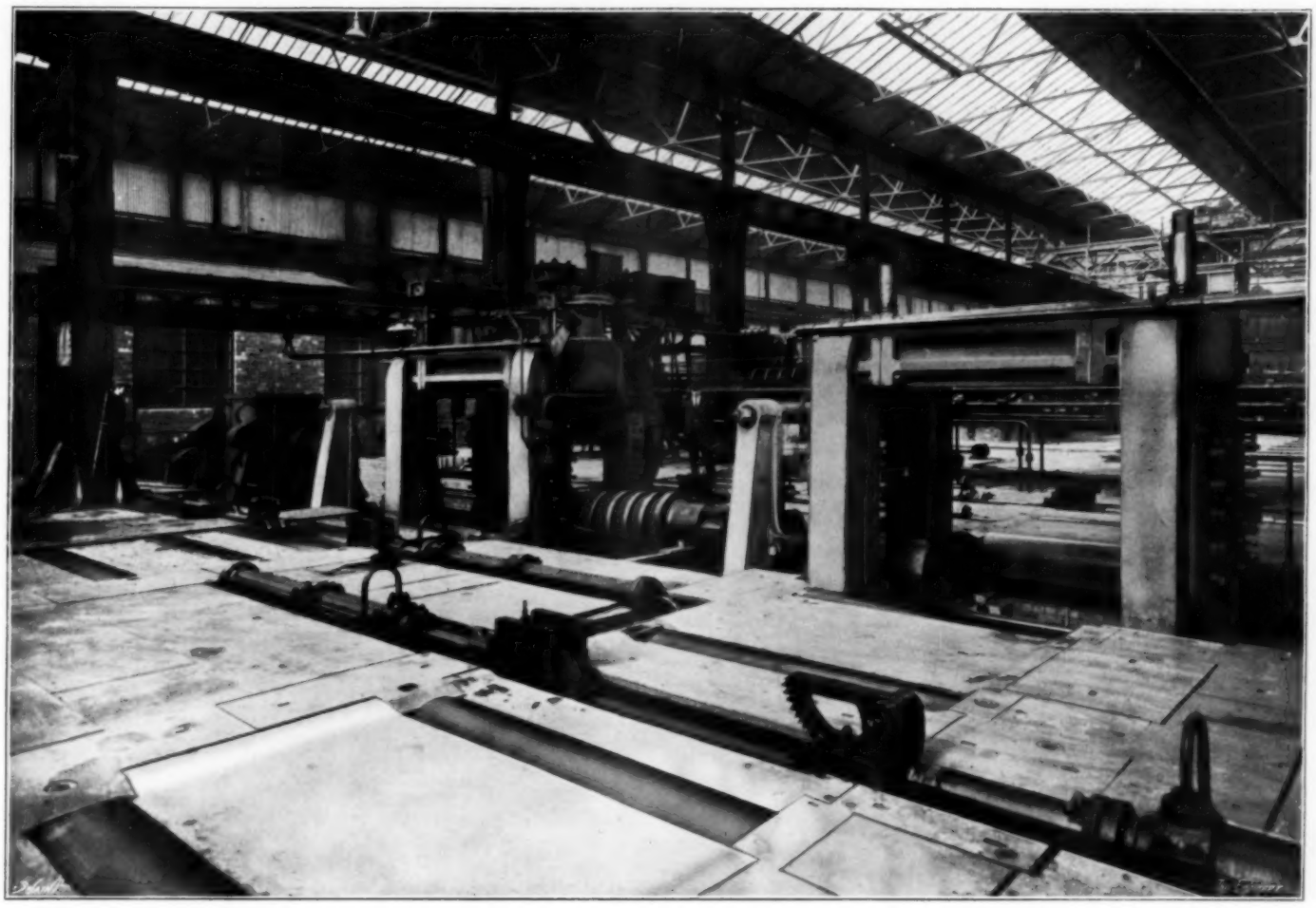

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*** *With this week's number is issued as a Supplement a Two-page Plate illustrating an Electrically Driven 28in. Rolling Mill at the East Hecla Works, Sheffield, of Hadfields Limited. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

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*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

AUGUST 11, 1922.

Twelve Months of Railway Decontrol.

We are now within four days of the first anniversary of the cessation of the Government control of the British railways, and one looks in vain for any of the great benefits that were to come when the railways threw off the shackles with which they had for seven years been burdened. Not even their best friends can show any improvement in the railways' situation. Wages have, since the cost of living reached the peak point at the end of 1920, dropped in most cases by twenty-one shillings per week per man, and Mr. J. H. Thomas says that the railway wages bill is now thirty millions a year less; coal is down to nearly one pound per ton, and if it be counted that ten shillings per ton has been saved, that means a total saving or seven millions a year, whilst material and stores are correspondingly less in price. But all that the traders have got in return is that the increase in rates made on September 1st, 1920, has been reduced from 100 to 75 per cent., together with about one-half of the flat rate increase. The ordinary travelling public has not got even that much; there has been no reduction in fares. The latter remain at 75 per cent. above pre-war, whilst season tickets are 50 per cent. higher than in 1914. Both these increases inflict a great hardship, especially on the suburban season ticket holder, who in years gone by was encouraged to go and live in the country, and who has become the railway companies' best customer, and gives them the least trouble.

Were we, however, given the disagreeable duty of having to pass judgment on the companies' action—inaction might be the better word—we should undoubtedly say that they had done their best under the prevailing conditions. The engineering dispute is over, but trade is still very bad and the general outlook most uncertain. Were the signs more favourable, the companies would, no doubt, do more. Many critics blame the Railways Act for the railways' alleged indifference. Whilst we do not see what ground there is for such a connection of thought—and we cannot admit the alleged indifference—we do blame the Railways Act for some portion of the present situation. Our reason for so doing is that under it compulsory amalgamation within a very limited period was ordered. The result is that, so as to make a good showing, the companies will not be venturesome, and they are all doing their best to swell their individual receipts and to reduce their expenditure. This is only natural. The fact that the companies must complete their grouping schemes by the end of this year is, though, turning out to be a blessing in disguise, in that the present period of inactivity will shortly be over. It is certain that as soon as grouping is carried through, each group will commence to spend money on works that will be for more economical operation. The settlement of the Eastern and North-Eastern Group will, it is certain, at once lead to the electrification of the Great Eastern suburban lines and of the North-Eastern main line between York and Newcastle. Many new connecting lines will be put in by the various groups; existing passenger and goods stations will be increased in size to allow for others in the same town to be closed; large marshalling yards will be built in order to deal with the longer engine runs that will then be possible; manufacturing and repairing shops at selected headquarters and centres will be enlarged and modernised, so that minor depôts may be dispensed with. This last should be a good thing for machine tool makers and the suppliers of electrical shop equipment. In many other ways will the groups spend money in order to save money. The outlook, however, for locomotive and rolling-stock builders is, we fear, bad, as the combined companies must have more than enough for the requirements of each group. It follows, too, that when the groups are arranged and the present necessity for a good showing is past, a further fall in rates and a generous reduction in passenger charges would be warranted. Until that time arrives, it would, we think, be unreasonable to expect the companies to do more.

The announcement made on the 4th inst. that financial arrangements for the Eastern, North-Eastern and East Scottish Group had been determined, is one that reflects very great credit on the companies concerned, and on the North-Eastern, which has been the prime mover, in particular. The latter company stood, as regards the whole of the British railways, in an enviable position, and it will be remembered that originally it was opposed to amalgamation. To join in the proposed Eastern Group, especially when the Scottish companies were added, and thus to act as a makeweight for some of its poorer neighbours, meant some self-sacrifice and no little loyalty towards the other companies. The size of the task may be appreciated when we say that the new group will be responsible for 38 per cent. of the whole of the British running track mileage and for over 31 per cent. of the locomotives. Except on financial matters, this particular grouping, like the Great Western Group, presented and presents fewer difficulties than the North-Western, Midland and West Scottish. To weld the Midland with the North-Western–Lancashire and Yorkshire is a big task, as there are so many points in policy and administration in which they differ. On the other hand, for seventy years there has been an East Coast combination, and for fifteen the Great Northern, Great Eastern and Great Central have in many respects been working in common. In coming to terms with the Lancashire and Yorkshire and then with the Midland, the North-Western Company accomplished the greater half of its task, but there yet remain the North Staffordshire, Furness, Caledonian, Glasgow and South-Western and Highland to bring in. The first-named is, in many respects, a fine bit of property, and one with a bright future before it. The situation as to the Southern Group has not, until recently, been promising. The constituent companies thought that the first step should be the amalgamation into one company of the three interests of the South-Eastern Company, the London, Chatham and Dover Company, and the South-Eastern and Chatham Joint Managing Committee. To this preliminary step there was considerable opposition by the Chatham proprietors, but that was overcome a week ago to-day. It may be useful if we add that the Railways Act gave the constituent companies until the end of this year to submit to the Ministry of Transport a scheme for their own amalgamation and for the absorption of the subsidiary companies in accordance with the first schedule of the Act. Failing agreement by December 31st next, the Railway Amalgamation Tribunal will itself prepare a scheme. Every amalgamation proposal and every absorption scheme must come into operation on July 1st next year

Wireless Telephony.

A report recently issued by the Radio Subcommittee, which was appointed to investigate the possibilities of wireless telephony, shows pretty conclusively that the problem of transmitting speech through the ether has not as yet been properly solved. It is true, of course, that communication has been established over several thousand miles, but the possibility of working a system

commercially over such distances is entirely another matter. According to the report, all the witnesses who were examined agreed that for the transmission of a specified message over any distance, whether it be long or short, the radio telephone is inferior to wireless telegraphy as regards accuracy, speed and cost, and will apparently always remain so. Whilst the articulation of the best radio telephone compares favourably with that obtained on a trunk land line, it is necessary to repeat or spell unusual words and to repeat figures. Furthermore, it is not considered that wireless telephony would reduce the cost of operation, for all the witnesses agreed that the skilled *personnel* necessary to work a large radio telephone installation or a number of small installations is approximately the same as that required to maintain similar wireless telegraphy stations. The spheres of utility of the two systems are as distinct and as clearly defined as those of land line telephony and telegraphy. Apart from the greater convenience of line telephony, mutual interference rules out the radio telephone for ordinary local connections, and it is considered that the most important applications of the wireless system on a commercial scale are in connection with links between ordinary land line telephone systems, or communication with isolated posts, lightships, &c., where the laying of a cable would be expensive or impracticable. The system might possibly also be used with advantage for short links in land trunk lines across swamps or virgin forests, where land lines are difficult to maintain, and for broadcasting intelligence and music for the general benefit of the public. Wireless telephony may, however, prove advantageous to certain persons who desire to convey information over short distances. The fighting services have, in fact, already done a good deal in the direction of developing wireless telephones for this purpose, and the need for similar commercial communication may, it is considered, possibly arise. When a ship is approaching a harbour, for example, direct communication between the master and the port authorities with regard to berthing and other matters might result in a considerable saving of time.

One of the most important matters referred to in the report, and one with which all who have carried out wireless telephony experiments are familiar, is that sufficient power must be used at the transmitting end to overcome all interference from other signalling or from atmospheric disturbances, the interference from which is very variable, both in respect of locality and season, and in certain places communications may be interrupted for hours or even days, notwithstanding that very high transmitting powers may be used. Atmospheric disturbances are, of course, a source of trouble in connection with wireless telegraphy, but in the course of the recent discussion on Dr. Eccles' paper on "The Imperial Wireless Chain," read before the Society of Arts, Senatore Marconi strongly opposed the author's proposal to build transmission stations every 2000 miles, and argued that there was no distance which could not be bridged if sufficiently powerful transmitting plant were used. The general conclusion that appears to have been arrived at as regards wireless telephony, however, is that in order to overcome the troubles arising from atmospheric disturbances the power must be so large that running and maintenance costs are excessive. With favourable conditions it is technically possible for speech to be transmitted over distances equal to those which can be bridged by wireless telegraphy, provided that working expenses and secrecy are of no importance. No organised experimental work, however, has been undertaken with a view to providing a reasonably secret service over such distances. As the wave lengths most suitable for long-distance radio telegraphy are unsuitable for radio telephony carried out in accordance with present methods, telephonic communication would have to be established for wave lengths which are known to be inefficient for long ranges. The conclusions which the Subcommittee has arrived at are that the development of radio telephony for long distances is in an extremely elementary stage, and no change is in sight which is likely to lead to its establishment on a commercial basis within a measurable space of time. For distances in the neighbourhood of 1000 miles it is possible that, in certain remote localities where the interference from atmospherics and other radio communications is not excessive, non-secret radio telephonic services, using wave lengths commonly employed by medium-power radio telegraph stations, might be established, although the power necessary would be much greater than that required for sending telegraph signals over the same distance. For ranges of the order of 200 miles and thereabouts, however, the position is more hopeful, for it seems that the lines on which experiments are at present being carried out will lead in a reasonable time to the development of a system of radio telephony which will approximate to the requirements of a commercial system. Radio telephony cannot, however, be recommended as a substitute for any means of telegraphic communication, except in those cases in which the special requirements can be met in no other economical way—as, for example, the case of broadcasting intelligence and general information, in which one expensive transmitting station supplies a great number of simple and cheap receiving stations.

Although the report does not show radio telephony to be as useful as many may have supposed it to be, it indicates the directions in which there is scope for further investigations. In view of the progress that has been made within recent years and the many able scientific men who are now engaged in wireless work, it will be strange if the difficulties which are now experienced are not ultimately overcome. New ideas are constantly being brought to light. In the *Wireless World* of July 22nd, for example, a description is given of Mr. E. H. Armstrong's latest super-generation circuit, which has been developed in America, and which enables short-wave signals at radio frequencies to be amplified to an extraordinary degree. The discovery relates to a method by which it is possible to make full use of reaction without causing the receiver to generate oscillations, and a remarkable feature of the scheme is that the amplifying power increases inversely as the square of the wave length. There are many directions in which there is room for research. The problem of overcoming the troubles which arise from atmospheric disturbances deserves the closest attention and will bring great honour, if not wealth, to the individual who solves it. Again, the thermionic valve, though a wonderful device, is inefficient from the point of view of the relative values of the input and output, and it would be a distinct advantage if a new and more economical method could be found for providing the electrons.

Chinese Engineering Notes.

(From our own Correspondents.)

Peking.

EVENTS are moving slowly in connection with the reorganisation of the Government, and there is still some doubt as to whether we can consider the political atmosphere clear. General Li Yuan Hung has assumed office as acting President, and is making every effort to come to some understanding with the South. Sun Yat Sen, the so-called President of South China, has fled from Canton, and it may be taken for granted that we have heard the last of this fanatic. Dr. Wu Ting Fang, formerly Prime Minister in Peking, and recently Minister of Foreign Affairs in the Canton Government, died suddenly a few days ago. Dr. Wu was a fine type of the old Chinese statesman, and it can be safely said that had he enjoyed better health during the last few years nothing would have persuaded him to join Sun Yat Sen's adventure in the South. The reorganisation of the Departments in the Central Government continues, and those interested in the supply of railway, telegraph and telephone materials are watching with considerable interest the results of the efforts of the new Minister of Communications. The one trouble in Peking at the moment is the lack of funds. How the Government is carrying on is a complete mystery, but it is known that desperate efforts are being made to obtain a loan of anything from 10,000,000 dols. to 50,000,000 dols. One thing is certain: the Government cannot meet its ordinary expenditure irrespective of the large sums that are being expended on the maintenance of General Wu Pei Fu's army. It is rumoured that the Government intends to "fine" General Chang Tso Lin 50,000,000 dols. for having brought about the war. If the war has resulted in the downfall of Sun Yat Sen, the reorganisation of the Central Government, and the unification of China, General Chang has done China a good service.

Peking Tramways.

Early in June it was announced that various tenders had been accepted for this scheme. The boilers (£25,236) are to be ordered from Babcock and Wilcox, Limited, through the Sentoon Overseas Trading Company; turbo-generators (£25,253) from Brown, Boveri and Co.; transformers (26,000 gold dols.) from Siemens China Co. (German); rails and accessories (305,431 gold dols.) from the French Thomson-Houston Company, through the Anglo-French China Corporation; rolling stock (£55,000) from a French firm represented by the Anglo-French China Corporation; overhead equipment from Siemens China Company (German). Certain work in connection with road widening has already commenced, and it is understood that this is in connection with the construction of the tramways. Until quite recently a German was chief engineer of the company, but he has now been dismissed and a Frenchman has been put in his place. What interest the Banque Industrielle de Chine still has in this scheme is a mystery, but it is understood that the local manager of that institution has now taken his seat on the board of directors. The more information that is received out here regarding the proposed activities of the Sino-British Trade Association the less that body is welcomed. With the possible exception of Major FitzHugh, one of the special travelling commissioners, none of the people connected with the management of the Association appears to have had any experience of China or trade in China, so how such an association is to assist in the development of Sino-British trade is difficult to imagine. There is ample room for such an association provided it is managed by people who know the country and its trade, and provided it confined its activities in certain directions. For instance, there is plenty of scope for an association which would devote its whole attention to the collection of information on all the various phases of trade in China. The American Commercial Attaché issues a most exhaustive report monthly on these lines, and covers practically the whole of China. No such information is available from the British Commercial Attaché, but there is no doubt the required information could be obtained from him and embodied in a general report. The American report is sent to practically every American in China within ten days of the date up to which it deals, and the information contained therein is of real practical value. One of the pamphlets of the Sino-British Trade Association states: "The Sino-British Trade Association is the outcome of a desire on the part of the leading Chinese merchants in the Far East to buy direct from British manufacturers and merchants and thus avoid the large profits made by unnecessary intermediaries." This statement is ridiculous. The Chinese want to buy their goods from the man on the spot, and naturally prefer a direct representative, but failing that they go to the agent or merchant representing the particular firm they want to deal with because it would be quite impossible for a trade association to give the required technical information and the necessary guarantees. For a trade association to work on these lines it would require a staff of some hundred technical men to deal with engineering matters alone. Another paragraph of the pamphlet states: "The Sino-British Trade Association is constituted on the same principles as a Chamber of Commerce." Perhaps it is not generally known that we have a British Chamber of Commerce in every business port in China. They do excellent work, and are managed by men of considerable experience in the Far East, and, in addition, work very closely with the Commercial Attaché's Department.

Shanghai.

Engineers returning from England to these shores recount a sad state of affairs as regards engineering business at home. There seems to be a general return to the conditions which obtained when engineering strikes became the order of the day some twenty-five years ago and business was disorganised owing to uncertain delivery. The wages have risen to nearly double what they were then, and production is greater but not per man, so apparently the unions have got all they wanted, and it now remains for them to realise what they should already know if they are craftsmen, and that is that to stop machinery and start it again incurs a loss. This loss is worth while if there is not work for the machine to do, but if there is work and the machine is efficient, it is unpardonable. This is given as a protest from China, and should not be taken as a criticism of either employers or employees, both of whom are victims of their inability to understand each other. In China more men rise from the ranks than in any other country, and there is no bar to affluence *vid* work, and yet the equipment of those that rise is exceptionally an intellectual one and gained by education and perseverance. The difference between the risers out here and the risers at home is that those out here continue to rise and work whilst those at home very often are satisfied with so much. The Chinese are possibly the most patient and industrious race on the face of the earth, and it is to be hoped that they will long continue to be so, for it would be disastrous to the world at large if this immense aggregation of productive power were allowed to run to waste for lack of enlightened help. The amount of British capital invested in China is very small compared to the amount of that capital invested in the Americas and Egypt, and yet this China has a much higher percentage of untouched resources than those countries. Here the market is vast once it is opened, whilst in those other countries it has long been opened and its scope nearly determined. The financial investments in this country should not necessarily be confined to the facilities offered by the Consortium, for there is a wide field of industrial enterprises in which money can be safely invested, and this investment generally means spending the money in the purchase of machinery and equipment. There is no fear of China ever being absorbed by any one nation

or nations in spite of Japanese activities. China is much more likely to absorb the foreigners as she has done hitherto. The way to invest in this country is undoubtedly by means of companies composed of reliable Chinese and British without any Governmental taint or very little of it, or just sufficient to prevent interference by either Government, but at the same time to get the necessary official support. The amount of Chinese money available for such joint enterprises is astounding, and there are many groups looking for the right kind of foreigners to work with. There is no doubt that stability of Government will be attained eventually by means of groups of foreigners and Chinese combining to undertake development work, such as railways, waterworks, electric light and power plants, roads, mines, and other similar undertakings. It is true that the foreigners will have to do all the work and find a large portion of the money, but the benefit accruing to the promoters will be immense in the resulting trade. The more money we put into such works in this country the safer it becomes for foreign trade, and the safer it becomes for the Chinese themselves. Eventually by this means the Chinese will acquire a confidence in their own ability to defy an unstable Government, and whilst they are thus working with reliable foreigners in attaining the accomplishment of an undertaking of lasting value, they will at the same time assimilate foreign methods and a more open mind as regards trade with the nationals that co-operate with them.

Hong Kong.

Chiefly because of the rapidly increasing population of this colony, the annually recurring water shortage is upon us once again. Advertisements have been inserted in all the local newspapers announcing a curtailment of water supply not only on the island of Hong Kong, but on the mainland in that part of the colony called Kowloon. On June 1st the official returns for water in storage on the island showed 552.41 millions of gallons as compared with 2,117.67 millions of gallons on the corresponding date of last year. The latest addition to the storage capacity of the island was the Ty-Tam-Tuk reservoir, which was completed in 1918, and which last year was full with 1,419 million gallons. A fortnight ago it contained only 407 million gallons, and the level is now very much lower. The Kowloon reservoir has only 32 million gallons, which is less than sixteen days' supply under ordinary circumstances. It is a curious feature of the history of the Hong Kong waterworks, which is managed by the Government, that the extensions have always lagged behind the increased demand. During the last thirty-two years there have only been six during which a constant supply of water has been maintained throughout the year. These were normally wet years. It is as far back as 1901 that Mr. Chadwick, the expert from England, who considered the problem, recommended the building of the great dam at Ty-Tam-Tuk, but this work was delayed and was not completed until 1918. It is a very fine piece of engineering work, and it is a lasting monument to Mr. Daniel Jaffe, the engineer, who so soon after its completion fell a victim to the malaria and general overstrain contracted during the construction of this great dam. Excluding India, it is the largest dam in Asia; it was designed and built entirely by Jaffe, who supervised himself the Chinese contractors. He gave his life to his duty, for he would not go on sick leave until the work was finished. The time has obviously arrived when further reservoirs must be built, for not only is the population of the colony rapidly increasing, but the industrial development which is quickly taking place will cause increased water consumption. Fortunately there is plenty of room in British territory on the mainland, but no doubt expert opinion will be required to advise the Government, as considerable expense will be involved. Needless to say, all of the extensive pumping machinery installed with the local waterworks was made in Great Britain. We have had the advantage of local consultations with Sir Maurice FitzMaurice concerning the harbour works. We have had telephone experts coming to the colony to advise the Government on the vexed question of the telephone system, and we had Mr. Chadwick out here from London years ago. No doubt we shall have a visit from some eminent consulting engineer who is an authority on waterworks. The colony is developing so rapidly that the matter has become very urgent.

Literature.

An Introduction to the Study of Metallography and Macrography. By LEON GUILLET and ALBERT PORTEVIN. Translated by LEONARD TAVERNER. With an Introduction by H. C. H. CARPENTER, F.R.S. London: G. Bell and Sons, Limited, York House, Portugal-street, W.C. 2. Price 30s. net.

A TRANSLATOR is responsible to a limited extent only for such faults in the original as reappear in the translation, but he is wholly responsible for the impression, so far as it depends on literary form, which the translation makes on the minds of his countrymen. In a a book on politics, philosophy, or morals, there may be a French point of view which a translator might endeavour to preserve, but there is no French point of view about metallography, any more than there is about the multiplication table. The translation of a technical book should, therefore, be as clear and intelligible as though it had been written originally by a capable Englishman. There is every kind of warrant for requiring this quality in technical translations. An accomplished student of languages and literature will be a Frenchman in Paris, an Italian in Rome, and an Englishman in London. When a foreign language is spoken really well, the speaker is not worried by any recollection of his Mother-tongue. It seems, therefore, proper to require an English translation to be presented in English, in idiomatic English, if you like, but not in idiomatic French or Italian, as it might be with some excuse if it were prepared by a foreigner not thoroughly acquainted with English modes of expression.

Mr. Taverner's translation may be less blameworthy in this respect than some other translations relating to metallurgy which have recently appeared, but it contains, nevertheless, examples which are quite unintelligible to students of metallurgy informed only through English sources and quite meaningless even to readers whose sources of information are less restricted. The most valuable part of the book, and the only part of it likely to make a strong appeal, as the translator hopes, to the practical engineer, is that covered by the twenty or thirty pages devoted to macrographic methods and results. Some of the illustrations—notably Figs. 540, 549 and 550—are likely to be more useful to the engineer than the scores of pages devoted to an overdone and not very successful attempt to tie together the general properties of alloys, and the appearance of fractured surfaces, with microscopic observations. It seems that Widmanstatten in 1808 was the first to conceive the idea of coarsely polishing metallic surfaces in order to examine them, after etching, with the naked eye or a low-power hand lens. This simple process is now called macrography. Associated with sulphur printing or some other form of contact printing, enabling records to be easily made in a form which may be conveniently preserved, it never fails to appeal to the engineer or works manager who is responsible for the design and manufacture of metal objects. It seems a pity, therefore, that books dealing with the structure of metals written ostensibly for engineers should not adopt this striking method of illustration and easy investigation as a starting point. There would then be some sure ground on which to build up an interest in micro-structures and thereby instruct the engineer, possibly, as to the meaning of and inveigle him to use equilibrium diagrams.

"When conclusions are drawn from microscopical, chemical, mechanical and other investigations carried out on one or more samples or test pieces, taken from various positions in the article or ingot considered, it is usual to assume that these conclusions are applicable throughout the whole mass of the material. This assumption to be accurate requires that the article shall be of uniform chemical and structural composition, and possess similar mechanical properties throughout the mass; therefore, any systematic examination should have, as a preliminary, some method of determining whether this uniformity exists." Perfect uniformity does not occur in industrial metals objects, though great diversity may occur, and the reluctance of many engineers to study details before knowing something of principles would therefore appear to be justified. Whether a house is habitable or not can obviously not be determined reliably by the pattern of the lace window curtains.

Professor H. C. H. Carpenter, who writes an introduction to the English edition, makes a distinction between metallography and macrography. "Macrography may be defined as the study of the 'coarse' structure of any given metal or alloy. It does not require expensive or complicated microscopic apparatus. It is a curious thing that in spite of this there should have been a much more rapid development of the science of metallography which definitely relates to the microscopic structure of the metal, and requires for its execution the use of comparatively expensive apparatus, such as microscopes with high resolving objectives, pyrometers, &c." However rapid the development of metallography may have been, it has certainly been amazingly uneven and marred by statements and contradictions of its leading exponents, which has left the student, whether younger or older, in a very confused state of mind. This subject has been exploited for teaching and examinational purposes, and is generally presented in text-books from that point of view. The engineer would like to use what knowledge he may acquire for workaday purposes, and should be recommended to begin his study of the subject on lines which do not require "expensive or complicated apparatus." He may, thereby, find that for industrial investigational purposes he will rarely require to add to his simple equipment.

The volume would gain in directness if it dealt with fewer metals or dealt with groups of metals in separate chapters, or made it quite clear to what metal or metals particular statements apply. But it deals with steels and swings cheerfully to lead or bearing metals without notice. That "forging may be performed at atmospheric temperatures or higher" may be useful information in relation to certain metals; in relation to metals in general, the statement has no practical meaning. Statements equally ambiguous or doubtful about cold rolling, the softening of nickel-chromium steels, the examination of welds and the uses of cemented bar iron, &c., occur throughout the book. To inform sundry readers who shave with a safety razor blade that "only mild steel can be cold rolled" is not a reassuring recommendation. This book, prepared for practical engineers, describes five different types of machines for polishing sections which are to be examined microscopically, but it does not mention that little machine, known as a "linisher," which is an invaluable means of preparing large or small flat surfaces for macro-examination. It also does not describe contact prints which were used by Sorby about 1860, and have since been developed by Humphrey and others. It does not mention Howes reagent, which is surely one of the best for macro-etching. It describes on a fraction of a page the making of a sulphur print. A longer description of this valuable process might be unnecessary as the process of sulphur printing is really as easy as it is useful. When, however, the authors are discussing the distribution of sulphur in a steel ingot, they use hand-tinted diagrams based on the results of chemical analysis! If a reader should chance to make an actual sulphur print of a sectioned ingot, he will conclude that either the sulphur print is woefully misleading or the authors' tinted diagrams bear no resemblance to the distribution of sulphur in ingots. A book to be of use to anybody ought not to land its readers in such a dilemma.

It has become the fashion nowadays to crowd into books on metallography—meaning by this term the various means by which metals may be examined apart from the process by which they are manufactured and worked—a host of refined observations and more or less attenuated speculations which are just redeemed from foolishness by the fact that they are remotely related to metals. Even those speculations which are not yet more than dream-stuff, may be proper material on which to sharpen the wits and feed the imagination of a restricted few; but the busy engineer to whom so much of it is addressed, and who is chided for his lack of interest in metallurgical research work, is entitled to much commendation for his apparent apathy. A great gap lies between what the engineer wants and what he gets by way of help and counsel from metallurgical literature. If writers of books would come down to earth and start their instruction from some point within general experience at which the student seeking useful information and the engineer seeking help can pick up the trail, they could rely on a host of grateful readers. So long, however, as the books are painful to read, starting out of reach and leading nowhere in particular, they will receive attention only from the coerced student and from the industrious enthusiast who fancies that wisdom comes from much reading.

BOOKS RECEIVED.

Der Kreisträger. By Dr.-Ing. G. Unold. Price 40 m. Verlage des Vereines deutscher Ingenieure, Berlin N.W. 7, Sommerstr. 4A.

Steel Thermal Treatment. By J. W. Urquhart. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 35s. net.

Coal in International Trade. By A. J. Sargent, M.A. London: P. S. King and Son, Limited, Orchard House, Westminster, S.W. 1. Price 2s. 6d. net.

Memoirs of the College of Engineering, Kyushu Imperial University, Fukuoka, Japan. Vol. II., No. 4. 1922. Fukuoka, Japan. Published at the University.

Untersuchungen an Kondensations-Luftpumpen. By Dr.-Ing. K. Hoefer. Price 60 m. Verlage des Vereines deutscher Ingenieure, Berlin N.W. 7, Sommerstr. 4A.

The Engineering Workshop Handbook for Fitters, Turners, and General Machinists. By Ernest Pull. Fifth edition, revised and enlarged. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 3s. 6d. net.

British Engineering Standards Association, No. 9, 1922: British Standard Specification and Sections for Bull Head Railway Rails. Revised June, 1922. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

British Engineering Standards Association, No. 154, 1922: British Standard Dimensions for Malleable and Soft Cast Iron Pipe Fittings for Steam, Water, and Gas. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

British Engineering Standards Association, No. 143, 1922: British Standard Dimensions for Long Sweep Type Malleable Iron Pipe Fittings for Steam, Water, and Gas. London: Crosby Lockwood and Son, 7, Stationers' Hall-Court, E.C. 4. Price 1s. net.

British Engineering Standards Association, No. 7, 1922: British Standard Specification for Dimensions of Insulated Annealed Copper Conductors for Electric Power and Light, including Pressure Tests. Revised May, 1922. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

Navigation Intérieure: Canaux—Cours Professé à l'Ecole Nationale des Ponts-et-Chaussées. Par O. Jacquinot, Inspecteur Général des Ponts et Chaussées. Revu avec la collaboration de F. Galliot, Inspecteur Général des Ponts et Chaussees. Un vol. gr. in-8 de 600 pages avec 244 figures. (Encyclopédie du Génie Civil et des Travaux Publics, publiée sous la direction de M. Mesnager, membre de l'Institut.) Paris: La Librairie J.-B. Baillière et fils, 19, Rue Hautefeuille. Price: Stitched, 45f. In limp covers, 55f. plus 10 per cent. for carriage.

BRIQUETTING PLANT FOR IRON ORES

(For description see opposite page)

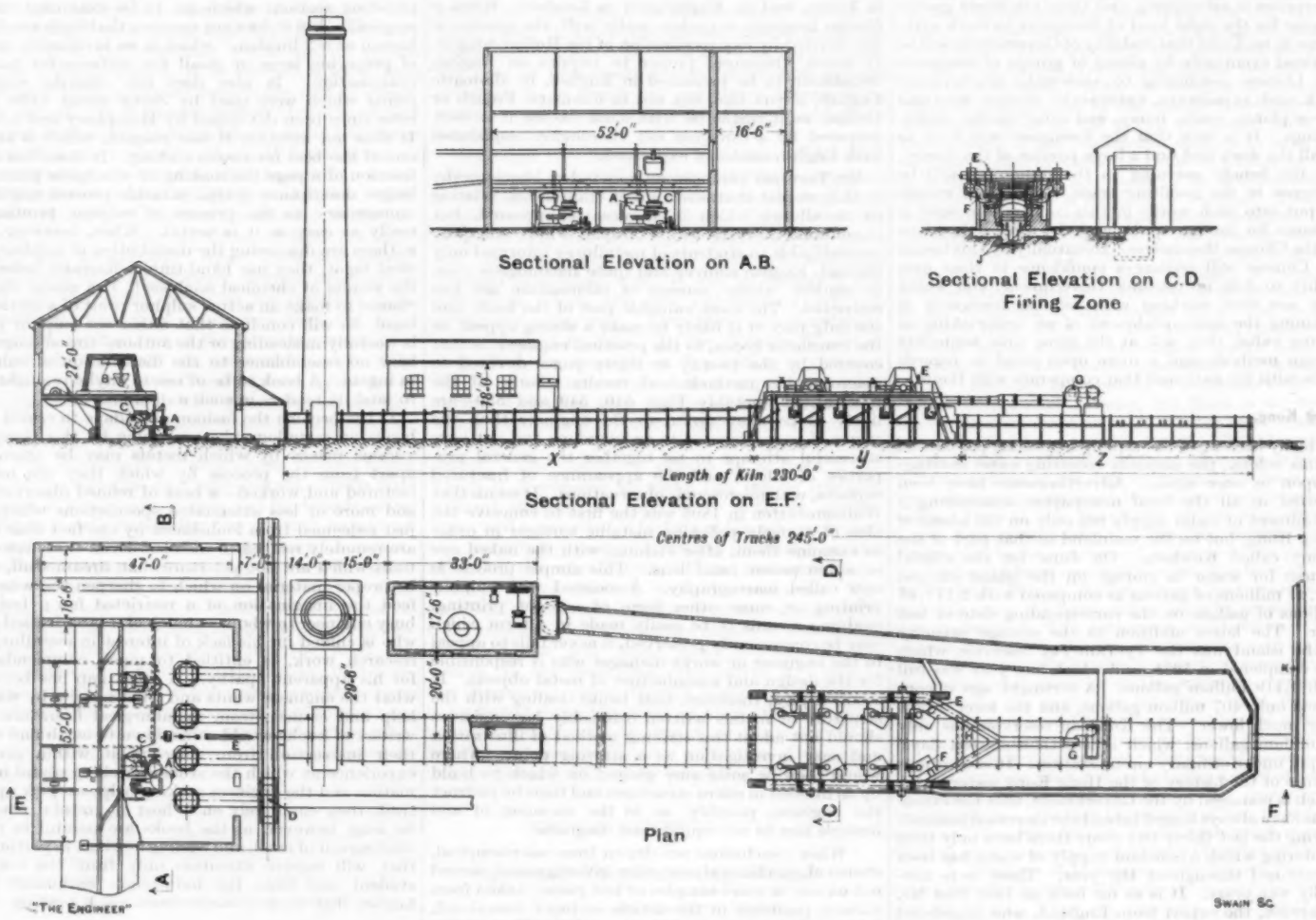


FIG. 1—ORE BRIQUETTING PLANT FOR SERAING

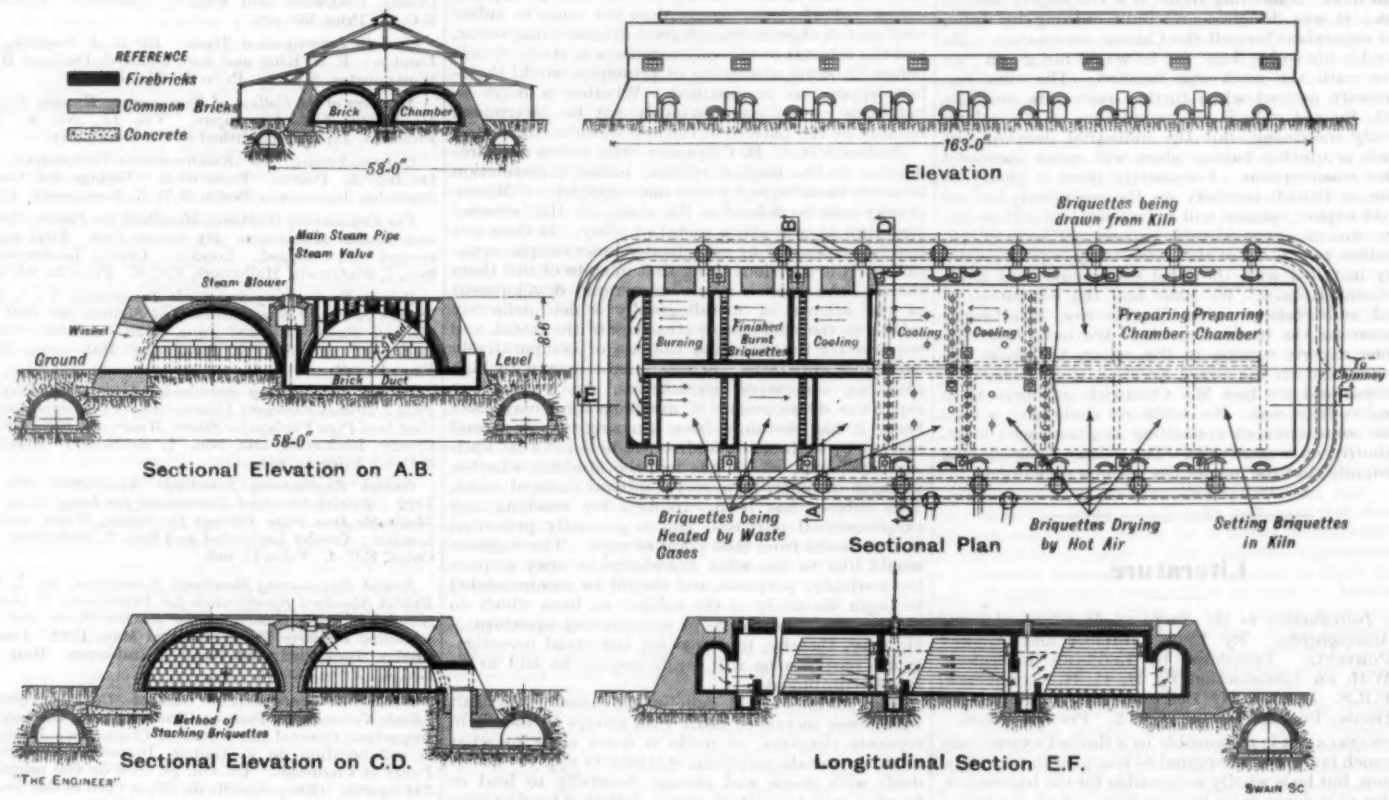


FIG. 2—SIXTEEN-CHAMBERED CONTINUOUS ORE BRIQUETTE KILN

Plant for the Briquetting of Iron Ores.

A BRIQUETTING and calcining plant has recently been erected by Sutcliffe, Speakman and Co., Limited, Leigh, Lancs., at the Cockerill Works, Seraing, Belgium, for the treatment of 150 tons of pyrites per day of twenty-four hours. The pyrites are briquetted without the admixture of any binding medium whatever, the briquettes afterwards being calcined in a tunnel kiln. A line drawing of the complete lay-out is given in Fig. 1, and will serve to convey a good idea of the general operation of the plant from the moment the ore enters the briquetting room to the time the finished briquettes are discharged from the kiln. The briquetting plant consists of two presses A, each capable of dealing with from 6 to 8 tons per hour, the ore being pressed into briquettes 7in. by 7in. thick. The pyrites are brought into the shop in tip buckets running on an overhead mono-rail B, each bucket carrying about half a cubic yard of ore, which is dumped through a coarse screen, to remove all large pieces of rock or other foreign bodies, down a chute on to an automatic feeder C placed directly over the feed pan of the press. The automatic feeder is so adjusted as to deliver the ore at exactly the rate required by the press, thus ensuring that the feed pan shall always carry the same weight of material and deliver a constant and regular feed to the moulds. The press is adjusted to give briquettes of the required thickness, and since the dimensions remain constant, the density may be regulated by feeding a greater or lesser amount of ore into the moulds. As the amount can be closely regulated, the briquettes, within narrow limits, remain constant both in size and density.

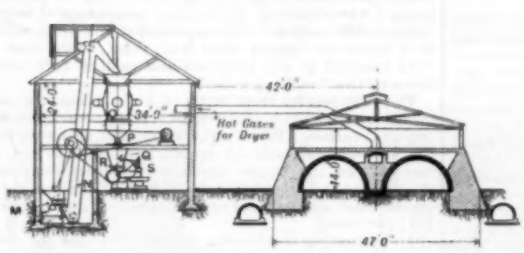
The briquettes are stacked by hand on wagons with substantial fire-brick tops. They are piled two high, giving a total height of 14in., and are arranged in herring-bone fashion, leaving a space between the rows of about 1in. through which the gases may pass freely. The wagons are 6ft. 6in. wide and are capable of carrying 324 briquettes, representing a weight of nearly 2 tons. As each wagon is filled with briquettes it is moved on to the transfer car D—see plan, Fig. 1—which carries it directly in front of the door of the kiln, into which it is pushed by the hydraulic ram E. On the next wagon being filled the same procedure is adopted, the wagon previously pushed in being, of course, moved its own length through the kiln. As the kiln is always kept full of wagons of briquettes, it follows that every time a wagon of green briquettes is added, a wagon of calcined briquettes is pushed out at the opposite end. In the plant under notice the wagons enter the kiln at intervals of twenty minutes, and each one takes twelve hours to pass through.

The kiln is constructed in the form of a tunnel 76 yards long, 6ft. 6in. wide internally, and is so arranged that the green briquettes coming are first gradually dried and heated up by the waste gases which are drawn from the firing zone through the kiln to the chimney. This drying and preheating space X—see elevation, Fig. 1—is 37 yards long, whilst the hot zone Y takes up a further 16 yards. The briquettes pass from this zone along the remaining 23 yards Z, where they are cooled off by the incoming cold air. The kiln is fired by blast-furnace gas, which is admitted by valves E to four tuyeres F arranged on each side of the kiln. Here the gas is mixed with hot air which has been heated up by its passage over the calcined briquettes in the cooling-off portion of the kiln. This air is extracted from the kiln by a suction fan G, which is connected to the tuyeres by a breeches piece of piping H. The firing zone in this kiln is very much longer than is usual, and each wagon is in it some two and a-half hours. An oxidising atmosphere is used. The makers claim that this is a very important point, since a great amount of trouble has been experienced with this type of kiln in so adjusting the mixture of air and gas as to calcine the briquettes sufficiently, without danger of reducing them. The temperature reached in the hottest part of the firing zone is between 1250 deg. and 1300 deg. Cent.

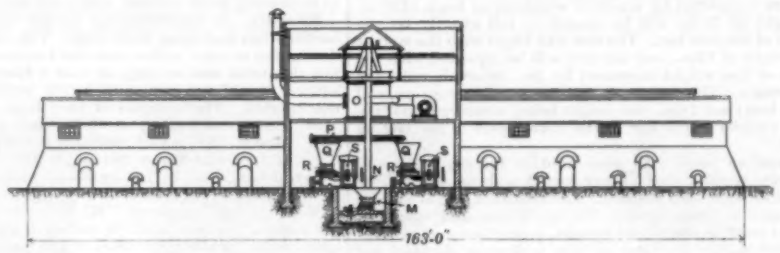
After passing from the firing zone the briquettes are brought into contact with the cold air coming in at the outlet end of the kiln. Here, whilst they themselves are sufficiently cooled to allow them to be handled, the air is heated before entering the tuyeres, which are water cooled. Along each side of the kiln there is a water channel J, through which dipper plates attached to the sides of the briquette wagons travel and effectively seal the lower from the upper portion of the kiln. In this way damage to the track and to the wheels and axles of the briquette wagons is prevented. The wagons of calcined briquettes on coming from the kiln are moved along the transfer track K to an unloading track, which carries them by means of an overhead cableway to storage bins, into which they are dumped, the empty wagons returning to the briquetting plant to be further filled.

When using a tunnel kiln for calcining briquettes it is necessary that the plant shall work continuously, and that the charged wagons shall enter the kiln every twenty minutes night and day. Such a kiln cannot, therefore, be used successfully for intermittent working, and once it is heated up should be ensured of a long run before being stopped. That being the case, it is, of course, necessary to have a spare unit in order that necessary running repairs and renewals can be made to one press whilst the other is supplying the kiln with briquettes.

Where a chamber kiln is installed the briquettes are stacked in the kiln with sufficient space between them to leave a free passage for the gases. On the chamber being filled the door is made up and regulating dampers opened, allowing the hot gases from another chamber which is being "burnt" to pass through, gradually drying and heating up the green briquettes. In such a plant as that illustrated in Fig. 3 the ore is dumped into the hopper over the automatic feeder M, by which it is fed at a regular and predetermined rate into the elevator N, which deposits it in a vertical drier O, where it is dried down to the required moisture content. It passes by gravity through this drier into a conveyor P, which has a right and left-hand screw, and which delivers it into hoppers Q situated over the two automatic feeders R, which then deliver the material into the feed pan of the briquetting presses S at the same speed as material is being used by the presses. The briquettes in this case are 10in. by 5in. by 3in. or 4in. thick and weigh about 15 lb. each after calcining. The pressure put on them is somewhere about 3 tons to the square inch. They are lifted by hand from the table and placed upon small wagons standing on the turntable T in front of the press, which are then wheeled to whichever chamber in the kiln is being charged, where the briquettes are stacked in open packing similar to clay bricks. In cases where various ores are being mixed for briquetting it is sometimes necessary to provide automatic measuring machines to ensure that the ores are mixed in their correct proportions. It may also be necessary in some cases to install grinding mills, generally of the edge runner type, to break down the lump ore and to assist further in intimate mixing.



"THE ENGINEER" Sectional Elevation on A.B



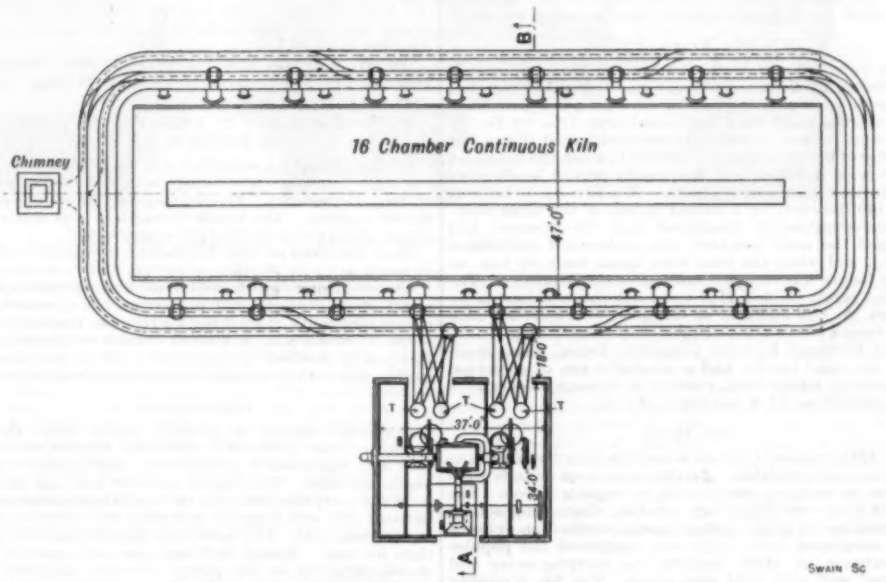


FIG. 3—ARRANGEMENT OF BRIQUETTING PRESSES AND KILN

In the illustration of a general arrangement of a sixteen-chambered continuous kiln—Fig. 2—the bottom right-hand chamber is the one which is being set with green briquettes, and the top left-hand corner chamber is the one wherein the briquettes are being calcined. By means of controlled dampers and flues the hot gases from that chamber can be passed into and through the other chambers which have been filled with briquettes, thus gradually preheating them in those chambers nearest to the one burning and drying those furthest away from that chamber by the gradually cooling gases. The cool gases are then passed into the main flue running along each side at the bottom of the kiln to the chimney. The chambers immediately in front of the chamber in which the bricks are being burned, and which contain hot briquettes, are used for heating the air for combustion. The door and dampers are opened and cold air allowed to pass in over the hot briquettes, cooling the briquettes, and at the same time heating up the air. When the briquettes have been sufficiently cooled the chamber door is opened and the calcined briquettes taken from the kiln to small wagons and delivered into trucks, by which they are conveyed to the blast-furnaces. This particular kiln is arranged for coal firing, the coal being dropped into the fire down the six feeding holes, shown in the sectional elevation, over the hearth. The most economical fuel for this class of kiln is nuts of a non-coking coal with a low ash content. Over a period of years the Shotts Iron Company has burnt briquettes with about 1¼ cwt. of coal per ton of briquettes. The chamber type of kiln has been adopted by a number of firms, such as the Shotts Iron Company, Shotts, near Edinburgh; Cuivres, Metaux et Produits Chimiques d'Hemixen, at Hemixen, Belgium; Messrs. Harrison, Blair and Co., Farnworth,; and Les Aciéries de Paris et d'Outreau.

It will be noted that the fire hearth in each chamber is really a gas producer, but producer gas, coke oven or blast-furnace gas may be used for firing purposes.

Semi-Steel.*

IN making reference to "semi-steel" it has to be admitted that the name is misleading and that it is desirable that proper specifications should be prepared for the various classes of this material. The name is popularly applied to the metal resulting from the use of mild steel added to the pig irons and scrap melted in the cupola or furnace. The writer wishes to make it clear from the first that the semi-steel described in this paper is produced in the cupola, using coke as fuel and the usual air blast. His experience is confined to this practice, and the results obtained and conclusions put forward are the results of over twelve months' continual experience on a fairly large scale, and since then in greater variety of subject, but on a smaller scale. The percentage of steel used varied from 15 to 40 per cent., the lower figure for light work and the higher proportions for heavier castings.

Semi-steel does not displace either steel or malleable cast iron. The steel scrap in its passage down the cupola, by absorbing carbon, gradually loses its identity as steel and becomes iron. The metal resulting is simply a high-grade cast iron with fewer impurities and better physical structure. Test bars, when pulled, show no elongation, and there is practically no ductility.

It is the practice of some firms to melt steel scrap in the ladle and call the product semi-steel, but this method is seldom of any practical use. In the first place, the proportion of steel taken up by the molten iron is very small, not much over 5 per cent. in favourable conditions; the steel does not have the chance of being properly mixed and has a tendency to show in patches of uneven grain and hardness. Semi-steel is now being largely worked and its use steadily making headway, and the time has come now for the British Cast Iron Research Association, in co-operation with the Institute of British Foundrymen, to formulate a more correct and scientific name for the material and, if possible, prepare specifications and standard tests.

Ironfounders to-day are being called upon to produce castings of better quality which will machine satisfactorily, to meet the developments of higher speeds and greater efficiency in the engineering industries. They are asked to reduce weights; the standard of tests is being raised in many quarters, and all round more is being demanded. To maintain the use of cast iron for engine cylinders, turbines, compressors and innumerable classes of engineering and electric castings, the claims of semi-steel are well deserving of the most serious consideration.

PROPERTIES.

Semi-steel is stronger than usual grey cast iron as regards transverse, tensile, compression and impact tests. It is superior in regard to elasticity, toughness, resistance to shock and wear. Properly made, it is close grained, homogeneous, free from hard spots, blow-holes or defects. The graphitic carbon is finely broken up, the phosphide eutectic small, well distributed and frequently in well-defined mesh formation. Semi-steel is much superior to grey iron for machining. It takes a finer polish, while two very striking characteristics are its faculty for taking a clean-cut screw thread and a clean punch impression. Owing to its good physical structure resulting from the close grain, the formation of the graphite, combined with its high tensile strength, semi-steel has proved satisfactory

* Abstract of a paper read by Mr. J. Cameron, of Kirkintilloch, before the recent Birmingham conference of the Institution of British Foundrymen.

for such castings as cylinders, pistons, gear wheels and castings called upon to withstand wear and friction. Mr. McLain claims that it is a self-lubricating metal, and from general experience at home and abroad it has been found an excellent metal for the castings mentioned and for many other purposes. From experience it has been found that when semi-steel has been supplied for various castings the buyer soon finds out its qualities, and in some cases asks for this material in all his castings.

Munitions.

The writer's introduction to semi-steel was in connection with munitions. Early in 1917 he subscribed to McLain's system, and towards the end of that year, when approached by the Ministry, was unable to undertake the manufacture of aerial bombs in this material. One cupola had been lined to 40in. diameter on lines laid down by McLain and samples submitted. These proved satisfactory, and in a short time they were turning out semi-steel on a large scale. On one particular type of bomb 1400 castings were produced daily. Our own Government was comparatively late in using semi-steel, although it had been proved satisfactory by our Allies the French and by the enemy. In America towards the close of the war a huge programme for the manufacture of semi-steel shells and bombs had been arranged. The specification for these called for a tensile strength of 32,000 lb. on a bar cast 1¼in. diameter machined to 1.128in., and also for an impact test as follows :—

"The test specimen, 1¼in. square and not exceeding 1.52in. on any side, shall be cast with a length of 8in. and a riser of 4in. After removal of the riser, the bar will be placed on two knife-edge supports 6in. apart, which in turn are supported by an anvil weighing at least 1750 lb. A weight of 25 lb. will be caused to fall exactly on the middle of the test bar. The test will begin with the weight at a height of 12in., and the test will be repeated with the height of the weight increased by ½in. intervals until the bar breaks. The height of fall for causing rupture will not be less than 18in., this height being measured from the upper surface of the bar to the lowest part of the testing weight."

Special air tests with soap solution for gas shells and hydraulic tests of 4500 lb. per square inch for 6in. calibre and under were also applied. The results of actual use and experimental trials proved the usefulness and efficiency of semi-steel in shells and bombs, particularly as regards fragmentation. In view of the enormous demand for steel towards the close of the war, there is no doubt that semi-steel would have displaced steel in many instances.

Tests.

On over 400 test bars submitted to Ministry officials and tested by them the average result on a bar cast ¾in. diameter by 5in. long was over 18 tons per square inch. The average result on a bar turned from 12in. by 1in. by 1in. section gave 15 tons. It was anticipated that a fair number of bars submitted would fail to reach the minimum of 14 tons specified, but the results proved much more satisfactory than were hoped for. The first bar to fail was No. 140, followed by a second failure in the same week. On investigation it transpired that the foreman had changed the usual moulder, who understood the correct gating, and when the bars were again made by him no other failure was recorded until after the Armistice. The highest result yielded 21.9 tons, but this was beaten by Messrs. A. Ure and Co., of Glasgow, who attained 22.9 tons from a bar cast with 50 per cent. hematite pig.

The Diamond Foundry Company, Luton, using semi-steel on aerial bombs, had a wonderful run of seventeen consecutive tensile tests, yielding an average of over 21.1 tons, maximum 22.8, minimum 18 tons.

Pig Irons.

In 1918 ironfounders had to accept such brands of pig iron as were available. At this time most brands were erratic in analyses, particularly as regards silicon. The Scotch irons were found very suitable. Containing as they do total carbon about 3.60 per cent., medium phosphorus and manganese fairly high, they confirmed the popular dependence on their capacity for carrying scrap and blended well with mild steel scrap. The No. 1 quality was generally used, as machinability was most desirable. When a choice was available, preference was given to highest manganese. Some of the brands showed excellent fluidity, and when other brands were used the tensile strength invariably went up. Hematite irons used with steel scrap give very good results, and some remarkable tests have been attained by using 50 per cent. hematite. The steel scrap may be regulated to counteract the high total carbon in hematite, which is frequently a source of trouble in grey iron castings. Hematite was not available in 1918, or would have been more largely used. With a view of obtaining better tests, trials were frequently made of high-class irons, including cold blast, special brands, and special cylinder pigs. The results, so far as tests were concerned, were invariably disappointing, as no increase resulted, but occasionally very fine metal was obtained.

One of the strongest arguments in favour of semi-steel is that a founder can use the common irons in everyday use, and by judicious mixing with steel scrap can obtain results only otherwise possible by the use of cold blast or expensive special irons.

Scrap.

Mild steel boiler plate or sections used for stamping of thickness varying from ⅛in. upwards in fairly large pieces may be used. There are brands of mild high-tensile steel and high-manganese steel from which many varieties of stampings are made that give excellent results. Steel punchings 8in. diameter of 1in. thickness have been successfully tried. Borings, turnings and small punchings under 1in. diameter should be avoided, as they lead to troubles occasioned by oxidation, and frequently very small pieces drop into bottom of bed before being thoroughly melted—a frequent cause of hard spots.

Analysis.

The average analysis of aerial bombs referred to reads as follows :—

Si 2.13, S 0.065, P 0.60, CC 0.520, GrC 2.55, Mn 0.624.

This is not claimed to be an ideal analysis, but proved to be satisfactory for the castings in question. It could be improved by lowering the silicon and increasing combined carbon and manganese. The above analysis yielded excellent tensile tests and was found to be easily machined. It may be stated that it was not possible to procure the pig irons available in normal times and the best had to be made of the brands obtainable.

It will be noticed that total carbon is low, sulphur and phosphorus within safe limits. There is no doubt that greater strength would have been obtained by a closer approximation to Mr. F. J. Cook's silicon-carbon formula enunciated in his valuable paper on Diesel engine castings or to the continental empirical formula (total carbon plus silicon = 4.50), but it must be borne in mind that semi-steel freezes more quickly than grey iron, and the problem was to cast very large quantities, the thickness being under ¾in.

In semi-steel some interesting results in regard to silicon were noted. The analysis of the test bar was Si 2.35 per cent., CC 0.802 per cent. This bar was attached to the bomb and moulded in green sand. A gate about 1¼in. diameter was taken away by an official of the Ministry, analysed and tested. Although the silicon was in this case over 3 per cent., the bar actually yielded a tensile strength over 18 tons. Silicon over 2 per cent. was frequently used in much heavier castings with good results. While a wide range of silicon was found harmless, semi-steel seems sensitive to phosphorus and sulphur. Cleveland iron is largely used by Scotch founders for their light work, and was tried for semi-steel. The resulting castings contained over 1 per cent., and were invariably brittle and lower in tensile strength.

The sulphur in analysis given is low, and was assumed as indicating good melting and good coke.

Recently, in endeavouring to get harder semi-steel, harder irons and scrap were used. The coke obtained was during the miners' strike, and the hardness was obtained, but the metal was so sluggish that a Keep's test bar, ⅛in. square, would not run, and a 1in. square bar was not machinable. The analysis of two days' results were :—

Si, 1.938 and 1.074; S, 0.150 and 0.143; P, 0.740 and 0.320; CC, 1.060 and 1.390; GrC, 1.82 and 2.04; and Mn, 0.260 and 0.340.

Two test bars, 15in. by 1in. by 1in. at 12in. centres, resulted in transverse strength of 36.8 cwt. and 40 cwt.

Mr. Field, in his paper "What is Semi-steel?"* gave his sulphur content with 10 per cent. steel as 0.110 per cent., with 20 per cent. steel 0.125 per cent. The firm with which he is connected were turning out successfully the same bombs. With this percentage of sulphur it would have been impossible for the writer's firm even to pour the castings.

Mr. W. J. Evans, in a paper†—"Another Perplexing Foundry Problem"—given to the East Midland branch, gave the following analysis :—

Si, 2.35; S, 0.051; P, 0.63; CC, 0.64; GrC, 2.66; and Mn, 0.76.

He stated that his semi-steel was used for intricate thin castings involving machining with expensive milling cutters. He remarks, "This is practically identical with the Scotch analysis. The tensile strength of this material is almost always over 16 tons per square inch."

Semi-steel does not owe its qualities to chemical analysis so much as to its physical structure, and in its structure—almost identical with cold-blast iron—is revealed the secret of its strength and properties. It is essential to ensure continuity of good results to make frequent microscopic examinations, or consult competent metallurgists. Analysis is excellent in itself, but must be considered in conjunction with the physical structure and cupola practice.

Difficulties.

Semi-steel cannot be properly made under the too common "rule of thumb" methods. Considerably more care and organisation is necessary, and constant supervision essential. The cupola practice and fuel must be good and everything entering the cupola must be accurately proportioned and weighed, especially *air*. Correct gating is very essential. The gates and runners must be larger than for iron. Special skill and care and repeated trial should be given to the gating of every semi-steel job, particularly when required in large quantities and when several castings are in a flask. It must be melted hot and poured quickly.

One disadvantage in regard to semi-steel is that while it is comparatively easy to maintain good results when worked daily on a large scale, the writer has to admit, after considerable experience, that to ensure the best results it has to be handled on a fairly large scale. When only one or two charges are required, they can certainly be produced and ordinary iron reverted to, but the results are never so good, so far as tests are concerned, as when melted on the larger scale.

Semi-steel is more sensitive to damp sand than grey iron. Sand should be as dry as possible and the "swab" used with discretion. A development on the lines of very dry sand, sufficiently open, hard-rammed, is probably an improvement in the near future.

Cupola Practice

This is a subject on which foundrymen hold varied opinions. Good results are sometimes obtained by unorthodox methods, and it is impossible to lay down hard-and-fast rules. Whether the bed be high or low, whether one row of tuyeres or ore should be used, depends on individual experience, on the nature of the blast, and the chemical and physical properties of the metal and fuel used. Each cupola should be made a special study in itself and persevered with until it gives regularly from day to day its proper quantity of good hot metal and is clean at the end of its day's work.

The writer, in reference to cupola work, can only speak from his own experience. For semi-steel a cupola about 36in. to 42in. inside lining is preferred. In this size control is easier and the air can be forced to the centre with comparatively little pressure. One row of tuyeres was used, placed as low as the fettling door permitted. To ensure soft blast the tuyere area was increased to a 1 to 4 ratio, the tuyeres forming practically a continuous belt. All metal and fuel charges were weighed and, at first, air regulated by counting the revolutions of a positive blower; latterly, by a blast volume meter. The charges were small—10 cwt. of metal—each charge drawn by itself into bogie ladle and taken away for immediate pouring. These small charges, evenly distributed, seem to facilitate the free working of a cupola and maintain the melting zone at its proper level. Care should be taken with semi-steel to ensure *clean* metal scrap and fuel.

In more than one instance, when the bombs were cast from metal melted with high-blast and small tuyere area, the resulting castings were hard and difficult to machine. On altering the tuyere area as indicated this defect was at once put right.

Melting of Steel.

From observation it was noticed repeatedly that when one or two charges of semi-steel were in cupola the charge of ordinary grey iron immediately in front, when tapped, gave indications of the presence of steel. From this it was concluded that the steel scrap, although invariably placed on top of charge, was melting before the pig iron. Confirmation of this was obtained on Armistice Day, when the cupola containing semi-steel charges was drawn just before blast was put on. Pieces of the steel scrap in the first charge had melted round the edges while the pig and iron scrap showed no signs of fusion.

Recently experiments have been carried out with a view of ascertaining the amount of carbon absorbed by mild steel when it melts. Bars of mild steel were placed in contact with incandescent coke under air blast until fusion took place. Drillings were taken as near fusion point as possible, and at even distances of about 1in. The results gave surprisingly low figures, the highest percentage being 0.648 of carbon, the average percentage of four bars being 0.530 carbon. The experiment was then repeated in a miniature cupola filled with coke. Mild steel bars were inserted at 6in. intervals and each in turn brought down to the "melting zone."

The first results from trials in a 7in. diameter cupola on fifteen bars gave an average carbon content of 0.386 per cent. carbon. When repeated in 12in. diameter cupola the average was reduced on six bars to 0.25 per cent. carbon. In the larger cupolette sufficient temperature was attained to procure masses of molten metal in the bed, and on analysis the total carbon absorbed in this case was 1.97 per cent.

An interesting feature was that in every case the melting took place on top of the bars. There were no facilities available for recording temperatures of cupolas, but the steel bars melted easily. The results were unexpected in the low amount of carbon absorbed at the melting stage, much larger figures being anticipated.

In actual practice there is doubtless further absorption of carbon until, in the writer's opinion, about 2 per cent. is attained. This figure varies with height of bed and cupola practice generally.

Heat Treatment.

From trials it has been ascertained that when semi-steel is annealed at a temperature from 760 deg. to 800 deg. Cent. it loses considerable strength, in tensile strength the reduction varying from 25 to 33⅓ per cent., but the resulting metal was found to be very soft with a certain amount of malleability and ductility. [Some micro-photographs of a test bar as cast, heated to 760 deg. Cent. for two hours, then slowly cooled, re-heated for a further four hours at 760 deg. Cent., and slowly cooled in muffle were reproduced in the paper and the author explained that Mr. McLain, in one of his pamphlets, shows a bar cast from white iron and steel scrap, which, after a prolonged heating, could be twisted.—Ed. The E.]

With semi-steel of the average analysis given the best results seem to be obtained by one annealing and slow cooling. Strength is reduced and deflection slightly increased. To obtain more marked results low silicon and phosphorus with the carbon mostly in the combined state would be necessary.

In the paper to be presented by Messrs. Campion and Donaldson some interesting and remarkable results have been attained by heat treatment of semi-steel at low temperatures, the loss of strength at temperatures up to 700 deg. Cent. being considerably smaller than shown by ordinary cast iron.

Addendum.

Mr. J. E. Fletcher, M.I.M.E., has been good enough, in an unofficial capacity, to submit some notes on semi-steel practice based largely on his own and on continental experience. These may be summarised as follows :—

(A) Suggested Analysis to Ensure Best Physical Properties in Cylinder, Hydraulic Valves and Fairly Heavy Munition Castings.

	Per cent.
Total carbon	2.8 to 3.2
Graphitic carbon + Combined carbon	3.0 to 3.2
Silicon	1.0 to 1.5
Manganese	.6 to .9
Phosphorus	Under .30

(B) Relationship of Total Carbon to Silicon.

For castings 2in. thick and above the total carbon per cent., plus Si per cent., should be 4.2; between 1in. and 1¼in. thick, it should be 4.3; between ½in. and ¾in. thick it should be 4.5; and between ¼in. and ½in. thick the figure 5.0 is given.

(C) Cupola Practice.

(1) Hot and rapid melting is necessary so that the steel does not carburise too rapidly in its descent through the cupola.

(2) The charges of steel scrap, pig iron and coke should be light, the metal charge having a maximum depth of 4in. to 5in. when the coke used is in ratio of 1 to 10 of metal melted.

(5) The coke used should be of the best, low in ash, high in carbon and of strong physical character and reasonably porous.

(4) The amount of air used should not exceed 30,000 cubic feet, or, say, 2300 lb. weight per ton of metal melted.

(5) The blast pressure should not exceed 8 oz. for 24in.

* Appeared in the *Foundry Trade Journal*, March 31st, 1920.
† Appeared in the *Foundry Trade Journal*, August, 1920.

to 36in. cupolas, 9 oz. for 36in. to 48in., and 10 oz. for 48in. to 60in.

(6) The following figures, being the total tuyere area per cent. of the cupola area inside lining, are suggested :—For a cupola of 20in. diameter the tuyere area should be 30 per cent.; for 40in. diameter, 25 per cent.; for 50in. diameter, 22 per cent.; for 60in. diameter, 20 per cent.

(7) The depth of well or hearth of cupola below the tuyeres should not be too great, 15in. to 18in. being good practice.

(8) The steel scrap should not be too thick or too thin ($\frac{1}{4}$in. minimum and $\frac{1}{2}$in. maximum is a good rule). Very short pieces are unsuitable, as these tend, as in the case of turnings, punchings and the like, to segregate and promote irregular fusion and carburisation.

(9) The amount of air supplied per square inch of tuyere area per minute should not exceed 12 cubic feet, and the tuyeres should be well flared out at the inside of the cupola to at least twice the inlet area at wind belt. Flat rectangular shaped openings are better than circular ones.

(10) From the above it is evident that high velocity of blast accompanied by high blast pressures is prejudicial to good results. In actual practice, if each tuyere has an area (at inlet from wind belt) of one-thirtieth of the cupola area at the tuyere level, satisfactory results are obtained. A single row of tuyeres gives good uniform melting and generally better working than two or more rows of smaller tuyeres.

(11) Such design as indicated in the foregoing fixes the velocity of the blast at about 28ft. per second when traversing the tuyere inlet—this in the case of 48in. cupola. For small cupolas this velocity may be reduced to, say, 22ft., and for larger (60in. and upwards) increased to 34ft. per second, being influenced by the amount of blast penetration necessary.

(12) The height from tuyere level to bottom of charging door, governing the depth of stock column, is of importance, and for semi-steel practice may be given as twenty to twenty-four times the square root of the cupola diameter at tuyeres—

$$H = 20 \text{ to } 24 \sqrt{d} \text{ in inches.}$$

Thus a 36in. cupola would have a height from tuyeres to charging door of—

$$20 \text{ to } 24 \text{ times } \sqrt{36} = 120\text{in. to } 144\text{in.}$$

The higher figure is preferable as assisting rapid melting and economical working.

Mixtures.

The practice of making a semi-steel pig from a 40 per cent. (or 30 per cent.) steel mixture and of using this in conjunction with pig iron and scrap with or without a further 10 per cent. or 15 per cent. steel scrap yield good results, the metal being more homogeneous. It is bad practice to mix high-phosphorus pig iron with steel scrap owing to the different fusion points of low and high-phosphorus metals. Low total carbon content in the pig irons used is essential, otherwise the semi-steel will be too high in the total carbon and weak in consequence. The oxidation losses are greater when using high-carbon pig irons, and tend to the production of porous oxide charged metal.

Too much emphasis cannot be placed on the necessity for high-temperature melting and casting. Obviously the higher fusion temperature of 3.0 per cent. carbon iron calls for considerable superheat if fluidity is to be obtained. Moreover, the quicker the melting the less will be the degree of carburisation in the steel portion of the melted charge, and the lower the final carbon content of the metal produced.

Hematite pig irons admittedly give the best results in semi-steel mixtures. If the total carbon content is 4.3 per cent. minus, say, 0.29 per cent. for each per cent. of silicon content, a limit is reached. If the total carbon exceeds this the pig iron is of the high-carbon type and indicates high temperature blast conditions. Below this the graphitic condition is less coarse and the pig iron physically stronger. Thus the upper limit of total carbon for a hematite containing 3 per cent. silicon is 3.43 per cent. If higher than this the graphitic structure of the pig iron will be normally coarse, and Mr. Fletcher believes this coarseness persists in the semi-steel made therefrom, the worse as the silicon content is higher in the semi-steel. The high total carbon evil is more pronounced with phosphoric irons. Mr. Fletcher has shown elsewhere that each per cent. of phosphorus displaces about 0.39 per cent. of carbon. Hence the basis limit in a pig containing 3 per cent. silicon, $1\frac{1}{2}$ per cent. phosphorus is C 4.3 − (Si 3 × .29) − (P 1.5 × .39), or 2.9 per cent. total carbon. In some hot blast-furnaces such a pig may reach 3.5 per cent. total carbon, and it is exceedingly difficult to keep the carbon low in such irons except in small furnaces using low temperature blast. Hence the common fact that high-silicon, high-phosphorus irons absorb carbon rapidly in the blast-furnace hearth and in cupola much more rapidly than do hematite irons. Mr. Fletcher has always agreed with the author in his view that phosphorus in semi-steels should be kept low, for the reason given. It is not improbable that the higher limit for carbon in hematites, by reason of the absence of phosphorus, helps the fluidity by raising the proportion of the 4.3 per cent. carbon eutectic in the metal when hot melting is practised.

A New British Marine Motor.

We recently had an opportunity of visiting the works of the Ailsa Craig Motor Company, Limited, at Strand-on-the-Green, Chiswick, London, and of seeing there both under construction and on test a series of the new "Ailsa Craig Kid" engines, which the firm is now building. This engine has been produced as the result of the firm's long experience with marine motors, and it has been sought to embody in the design all the essentials of a marine engine, and by making the component parts suitable for multiple manufacture and eliminating all unnecessary parts, to combine English quality with American price.

The four views which we reproduce in Fig. 1 indicate the general outline of the 10–14 brake horse-power four-cylinder model. Operating on the four-stroke cycle with cylinders of $2\frac{3}{4}$in. bore and a stroke of 4in., the engine develops 14 brake horse-power when running at 1500 revolutions per minute on petrol or 13 brake horse-power at the same speed on paraffin. The cylinder and crank case are cast monobloc, with the centre lines slightly displaced, which facilitates the removal of the pistons and connecting-rods through the inspection door of the crank case. An interesting feature of the crank case is the method adopted for maintaining the oil level in it by using inclined troughs which are cast on the inner sides of each of the four compartments, these troughs carrying the oil to the front of the engine and ensuring the efficient lubrication of the forward connecting-rod bottom ends when the engine is lying at an angle in the boat. The main crank shaft is machined from a drop forging, and is supported at either end by ball bearings in the crank case and in the main casting of the reversing gear—see Fig. 2. The connecting-rods are steel stampings, with die cast white metal bottom end bearings and a bronze gudgeon pin bush, the gudgeon pin being ground to a floating fit and held central in the piston by two bronze pads.

A one-piece cylinder head is used, and to it are attached the cam shaft and the valve gear, an arrangement which allows of ready access to the cylinders and valves. The lubrication of the engine is entirely automatic, and the oil supply is taken from a tank attached to the cylinder, from which it passes by the action of gravity through sight-feed lubricators to the vertical shaft gearing to the crank case and the reversing gear. Affixed to the crank case at the fly-wheel end is the circulating water pump, which is of the marine plunger pattern, with a sliding suction valve. This pump is directly driven from the cam shaft. In Fig. 2 we reproduce a sectional drawing of the reversing gear, which is bolted to the engine crank case and forms with it a completely enclosed unit. The gears for reversing are of the epicyclic pattern, and run constantly in mesh, and the whole of the reversing and clutch gear is arranged so as to run in oil. A steel and bronze plate clutch is used, and it is operated from a cone on the main aft shaft, the clutch lever also operating the band brake which completely encircles the clutch drum. Details of this gear and also the inspection door for giving access to the clutch will be seen in Figs. 1 and 2.

The engine having been specially designed for open boat service, both the magneto and the carburetter are raised well above the crank centre line, and there are no small parts below this line. The high-tension magneto is waterproof, and it is driven from the crank shaft through skew gearing in the same manner as the vertical shaft. The distributor is so placed that it is easily accessible, and the high-tension leads are of minimum length. When running at full power, the engine consumes less than 0.7 pint of petrol, and about 0.1 pint of lubricating oil per horse-power hour. The weight of the engine and reversing gear is about 3 cwt. A two-cylinder Kid junior model is also made, the engine being of the same design.

We have briefly enumerated some points in the design of an engine, which shows both in its construction and its manufacture many interesting features, and its makers assure us that it has already achieved success in marine motor circles.

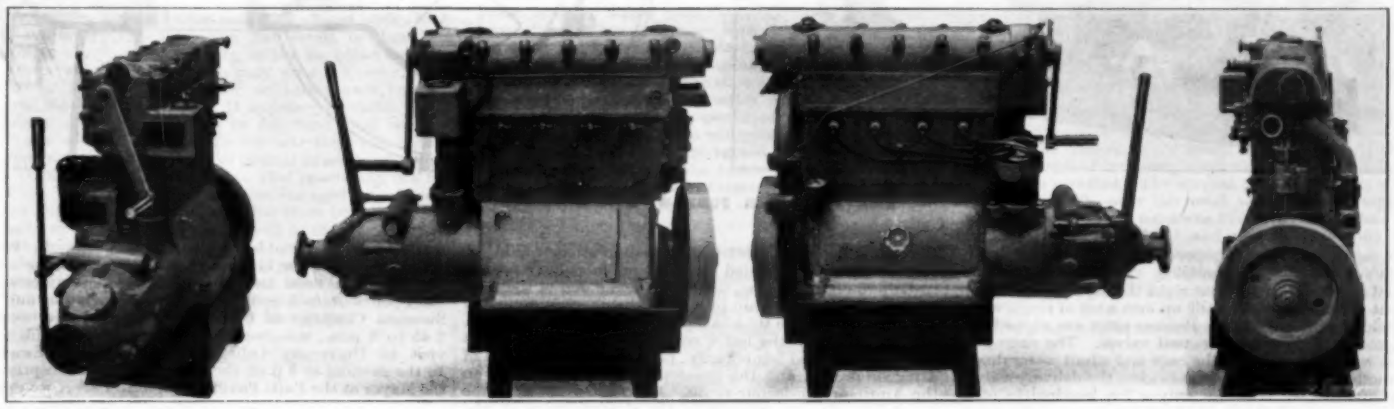


FIG. 1—SIDE AND END VIEWS OF THE AILSA-CRAIG 10-14-B.H.P. MARINE ENGINE

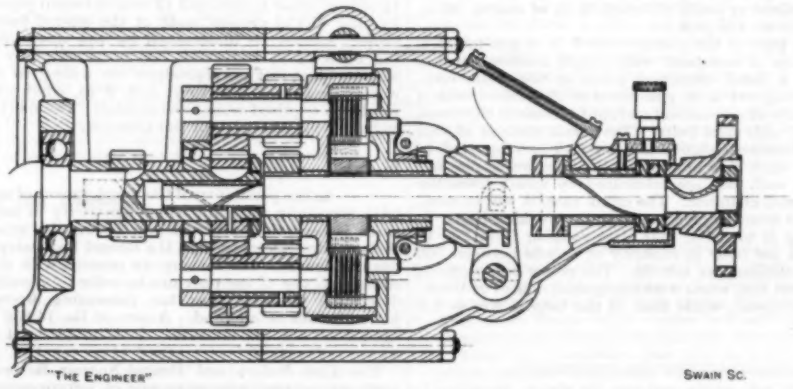


FIG. 2—SECTION THROUGH THE REVERSING GEAR BOX OF THE AILSA-CRAIG ENGINE

NATURAL GAS IN FRANCE.

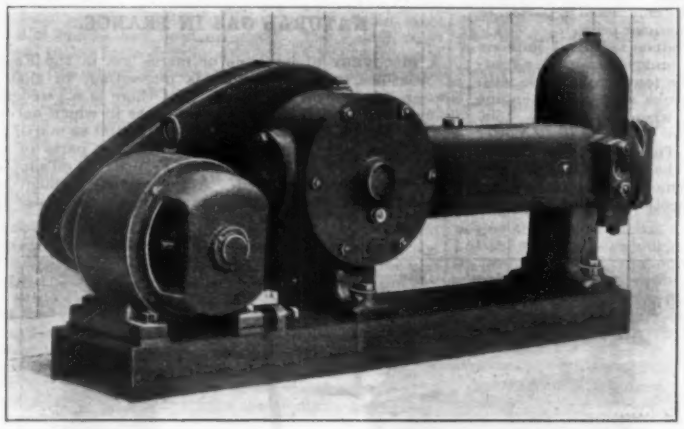
A discovery of methane or marsh gas in the Forest of Abatilles, near Arcachon, is interesting, in that it appears to confirm the theory that there is a geological fissure running diagonally across France in which natural gas can be obtained at workable depths, and as marsh gas occurs conjointly with petroleum in other parts of the world, there is considerable hope in France that oil supplies will eventually be tapped. A line drawn through the mineral water and gas sources from Alsace across the Central Plateau extends to the Landes, near Arcachon, but until the new discovery there has been no trace of marsh gas farther west than the Creuze. The fact of marsh gas being found at depths of from 30ft. to 60ft. at the extreme end of the supposed gas-producing zone is taken to imply that researches along the western part of the zone may produce results. The gas was tapped by a public works contractor while boring to a depth of 30ft., and he made two other bores of 60ft. and 130ft., when the gas arrived under great pressure. It is almost exactly the same as that found at considerably greater depths a few months ago at Vaux-en-Bugey, in the Ain, where the pressure has remained constant at 213 lb. per square inch. Mains are being laid down for the supply of the gas to Ambérieux and eventually to Lyons. In both cases the gas contains 81.24 per cent. of methane and 9 per cent. of nitrogen. The gas at Arcachon, however, appears to be under higher pressure than that at Vaux-en-Bugey. Following upon the discovery, a company has been formed to carry out development work. Although marsh gas suggests the presence of petroleum, the only oil supplies being worked commercially in France are at Pechelbronn, in Alsace, which, it may be added, is at the other end of the diagonal gas and mineral water zone.

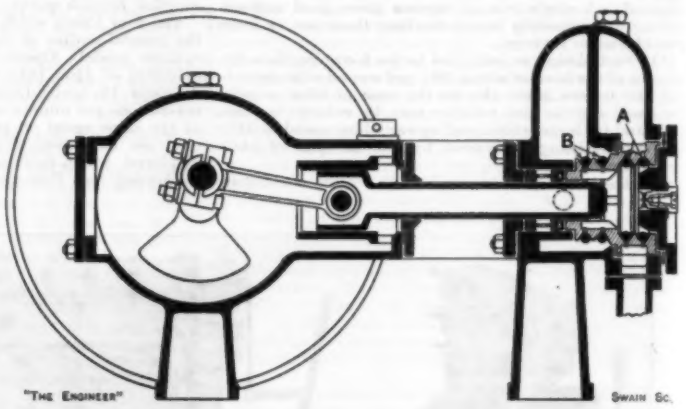
We learn that Mr. C. C. Champeney, the carriage and wagon assistant to the Great Western chief mechanical engineer, has resigned to take up the position of general manager to the Midland Railway Carriage and Wagon Company.

A Silent Plunger Pump.

A neat little pump, which has been brought out recently by the Pulsometer Engineering Company, Limited, of Reading, is shown in the accompanying illustrations. It is intended for services where comparatively small quantities of water have to be forced against fairly high heads, such, for instance, as in a large building where the ordinary pressure in the mains is not sufficient to take the water to the highest storey. For this reason the makers have aimed at complete silence in running, while the ram type has been adopted for the sake of efficiency. Even with these two conflicting requirements, it has been found possible to run the pump at such high speeds as 500 revolutions per minute, and thus not only reduce its overall dimensions for a given service, but also to drive it from a high-speed electric motor through single reduction gearing.

Such a performance is made possible by the type of valve adopted, which is plainly shown in the drawing. The





HIGH SPEED RAM PUMP WITH RING VALVES

valve cage has a series of grooves cut round it, some on its inside surface and some outside. These grooves are V-shaped in section and are cut right through at the bottom, so that the cage is really split up into a set of rings, which are held together by ribs. Rubber rings are slipped into the grooves and form the actual valves. The rings at A are, it will be seen, inside the cage and admit water during the suction stroke. The rings B form the delivery valves. They lift off their seats for only a few hundredths of an inch to provide a full opening for the passage of the water, and this movement is taken up by the compression or stretching of the rubber, so that there is practically no inertia effect, even at the high speed adopted, while the rubber rings naturally make no noise on their seatings.

All the valve rings are of the same size, and, if either should show any signs of wear or cutting on the parts bearing on the seats, the suction and delivery valves can be changed over, because the inside of the suction rings which are not exposed to wear will come against the delivery seats, and the outside of the delivery valves against the suction seats. The life of the valves naturally depends on the quality of the rubber, and for that reason the rings are made of the best possible rubber obtainable. To prevent any noise from water hammer, air vessels are provided on both the suction and delivery chambers, and to admit air to the delivery air vessel, a snifting valve, somewhat similar to the main valves, is fitted in the cover. As all the valves are of rubber, they always remain tight, and fine hard grit in suspension, it is said, will not affect either the valves or seats, although it is, of course, likely to cause wear on the plunger.

The front part of the plunger, which is of gun-metal, is made to form a crosshead with ample rubbing surface working in a bored crosshead guide in the crank case. The connecting-rod is of gun-metal of H section, with a solid eye at the crosshead end and split brasses at the crank end secured with steel bolts. The crank shaft is of cast steel with balance weights cast on and is supported in bearings on each side of the crank. The crank pin and bearings on each side are lubricated by splash from the oil in the crank chamber. The crank case, it will be seen, is fitted with doors to give access to the working parts.

The pump is made in four sizes ranging from 250 to 2000 gallons per hour in capacity at speeds between 500 and 300 revolutions per minute. The power consumption of the smallest size, when working against a head of 100ft., is 0.3 horse-power, while that of the largest size is 2.0 horse-power.

Indian Engineering Notes.

(From our own Correspondent.)

The problem of long-distance telephones is at present receiving the attention of the Telephone Branch of the Post and Telegraphs Department, and with the appointment of a special officer to deal with the telephone schemes of the Government of India great improvements are anticipated in the near future. The Punjab at present holds the distinction of being by far the best province in this respect, for it has direct telephonic connection between practically all its chief industrial centres, but when the Bombay-Calcutta and Bombay-Delhi schemes are put in hand, that distinction will disappear, for the development will spread all over the country.

Another interesting development in this connection is the increasing popularity of the automatic telephone system, and the latest scheme is for its adoption in the Bengal coalfield area, namely, at Loyabad, Sindi, Jherria, Assansol, Deshigarh and Ranigunj. This system will establish communication between all the important coalfields near Calcutta, but Calcutta itself will have to work through the manual trunk system at Assansol to get in touch with the coalfields.

Electricity in the Punjab.

The Punjab Electricity Board was recently formulated for the purpose of studying, and advising from time to time, the best means to be adopted to ensure the most economic development of the natural power resources of the province. At its first regular meeting held in Simla recently, an interesting report was read by Colonel Battye with regard to the Sutlej River hydro-electric project and the Nangal subsidiary project. After mentioning the progress that had recently been made in connection with the technical details of the project, Colonel Battye pointed out the advantages and disadvantages of the scheme and mentioned that by extending the Nangal project so as to supply the mills at Ambala, suitable educational work in the advantages of electrical mill operation would be obtained, and if extended by a second subsidiary project to Lahore and Amritsar, might overcome one of the difficulties faced by the main project in the delay in obtaining a market due to the time taken to get the mills converted. In enlarging on the latter subject he mentioned that it should be adopted temporarily, pending the completion of a bigger project and the development of the market on the Amritsar-Gurdaspur route. He pointed out that the possibility of postponement of the electrification of the Kalka-Simla Railway, the installation of two instead of three pumps for the new Simla waterworks, and the decision to work the Nalagarh quarries with steam power, necessitated the extension of the Nangal project so as to include Ambalia and possibly Patiala. In concluding, Colonel Battye foreshadowed great developments in supplying the north-west corner of the province with electric power, and that at a very early date.

Paper Pulp Manufacture.

The question of manufacturing paper and paper pulp from bamboos was recently investigated by the Industries and Commerce Department of the Mysore Government, and the advice of Messrs. Bertram and Sons, the well-known manufacturers of paper machinery in Edinburgh, was solicited in respect of the apparatus required. A scheme submitted by the firm showed that a capital of about £38,750 would be needed to produce 12 tons of straw boards and 13 tons of brown paper a week. In view of the present state of the official finances, the project cannot be undertaken by the Government, but the Director of Industries has been asked to ascertain whether any private capitalists are willing to come forward to establish a factory, and, if so, what concessions would be required from Government. The matter is now engaging the attention of the Director.

In Brief.

As the possibility of the development of new industries, especially those for which electricity in large quantities is essential, depends greatly on the existence of cheap hydro-electric power, the Bengal Legislative Council has decided that the measure to proceed with the hydro-electric survey of the province in order to investigate and determine suitable sites for generating hydro-electric power should be adopted. A sum of Rs. 14,850 has been sanctioned for expenditure. It is understood that the survey will extend over a period of six months.

The East Indian and Bengal-Nagpur Railways have both got extensive programmes of improvement in the service in hand, including the doubling of several stretches of the present line and also the construction of new lines, besides many other improvements of less importance.

So far two large glass factories in India have been obliged to close down, presumably owing to some defects in the original mechanical installation or the unsuitability of the sand obtainable in the areas of their situation. It appears necessary for the Government to appoint a special officer to survey the prospects of this industry in India and to advise prospective manufacturers of the results obtained by him.

The use of motor-propelled trolleys for platelayers is recommended in a report on the Western Australian Government Railways. The number of men engaged on the maintenance of way could then be reduced, as they would be able to get over the ground to and from their work more quickly.

The Institute of Metals.

The Autumn Meeting of the Institute of Metals will, as already announced, be held at Swansea from September 19th to 22nd next. The following programme has been arranged. On Tuesday, September 19th, the office of the hon. local secretary—Mr. Lewis Jones—will be open at 1 and 2, Royal Metal Exchange, Swansea, for the issue of tickets, badges, &c., and for general information. At 8 p.m., the annual lecture on subjects of practical interest to those engaged in the non-ferrous metals industry will be delivered by Dr. R. S. Hutton, member of Council, the subject being "The Science of Human Effort: Motion Study and Vocational Training."

On the Wednesday, at 10 a.m., there will be a general meeting of members in Llewellyn Hall, Y.M.C.A., when, after the Mayor of Swansea—Alderman William Owen, J.P.—has opened the proceedings with a brief address, papers will be presented and discussed. At 12.50 for 1 p.m. members will assemble at the Hotel Metropole, Wind-street, Swansea, for luncheon by invitation of the South Wales Siemens Steel Association, the Tin-plate Association, the Spelter Association, the Copper Association and the Swansea Chamber of Commerce. In the afternoon at 2.45 to 3 p.m., members will proceed to Brynmill for a visit to University College, Singleton Park, Swansea. In the evening at 8 p.m. there will be a civic reception by the Mayor at the Patti Pavilion, Victoria Park, Swansea.

On the Thursday at 10 a.m. the general meeting will be continued at the Llewellyn Hall, when further papers will be presented and discussed. In the afternoon there will be alternative visits to the following works:—British Mannesmann Tube Company's works, Landore, Swansea; King's Dock Works of Messrs. Baldwins, Swansea; the Grovesend Steel and Tin-plate Company's works, Gorseinon; steel, tin-plate and sheet works of Messrs. W. Gilbertson and Co., Pontardawe; works of Messrs. Williams Foster, Pascoe Grenfell and Co., Swansea—spelter, copper and yellow metals; Messrs. Vivian and Sons' copper works, Hafod, Swansea; and the English Crown Spelter Works, Swansea. At 8 p.m. there will be a concert at the Pavilion, Mumbles Pier, Mumbles.

On the Friday at 10 a.m. the general meeting at the Llewellyn Hall will be continued and concluded, further papers being presented and discussed as time permits. In the afternoon a motor tour will be made round the Gower Peninsula, *viâ* Killay, Llanrhidian, Cheriton, Llangennith, Burry Green, Reynoldston, Stouthall, Rhossily and Penrice, where tea will be taken in Penrice Park, by permission of Lord Blythswood.

The following communications are expected to be submitted at the meeting:—(1) Sixth report to the Corrosion Research Committee of the Institute of Metals on "The Nature of Corrosive Action and the Function of Colloids in Corrosion," by Dr. Guy D. Bengough and Mr. J. M. Stuart. (2) A report to the Aluminium Corrosion Research Sub-committee of the Corrosion Research Committee of the Institute of Metals on "Experiments on the Oxide Method of Determining Aluminium," by Mr. J. E. Clennell. (3) Professor J. H. Andrew (Glasgow) and Mr. Robert Higgins (Glasgow) on "Grain Size and Diffusion." (4) Mr. F. L. Brady (Birmingham), on "The Structure of Eutectics." (5) Mr. Maurice Cook (Cambridge), on "The Antimony-bismuth System." (6) Sir Henry Fowler, K.B.E. (Derby), "Note on the Effect of Superheated Steam on Non-ferrous Metals used in Locomotives." (7) Miss Marie L. V. Gayler (Teddington), on "The Constitution and Age-hardening of Alloys of Aluminium with Copper, Magnesium and Silicon in the Solid State." (8) Mr. F. W. Harris (Birmingham), on "The Hardness of the Brasses and some Experiments on its Measurement by means of a Stainless Indentation." (9) Mr. A. Jefferson, for the Sheffield Silver Trades Technical Society, "Note on the Cause of Red Stains on Silver-plated Work." (10) Dr. F. Johnson (Birmingham) and Mr. W. Grantley Jones (Birmingham), on "New Forms of Apparatus for Determining the Linear Shrinkage and for Bottom-pouring of Cast Metals and Alloys, accompanied by Data on the Shrinkage and Hardness of Cast Copper-Zinc Alloys." (11) Mr. Q. A. Mansuri (Cambridge), on "Intermetallic Actions: The System Thallium-Arsenic." (12) Messrs. A. H. Mundey (London), C. C. Bissett, B.A., B.Sc. (London), and J. Cartland (Manchester), on "White Metals." (13) Dr. W. Rosenhain, F.R.S. (Vice-president), and Mr. J. D. Grogan (Teddington), on "The Effects of Overheating and Melting on Aluminium." (14) Dr. R. Seligman (member of Council) and Mr. Percy Williams (London), "Note on the Cleaning of Aluminium Utensils." (15) Mr. D. Stockdale (Cambridge), on "The Copper-rich, Aluminium-Copper Alloys."

LOOM PATENTS EXTENDED.

Among the patents which have been extended under the new procedure of applying for extension by a summons in the High Court a patent for improvements in power looms for the manufacture of Oriental, Persian, wound and other knot-stitch carpets has been extended for four years, together with its patent of addition. The main patent refers to a loom for weaving tufted carpets with pile knots of the various kinds indicated above, the ordinary weaving and tufting operations taking place alternately and being actuated by independent drives. The tuft mechanism is mounted on a frame which is moved intermittently across the loom to form tufts on successive pairs or groups of warps, each pair of warps being passed through a loop attached to a guided hook, those in the series being raised in succession in order that tufts may be knotted to the corresponding pairs of warps. The action as a whole is somewhat complicated, and a full description may be found in Renard's Patent No. 15,901/06.

The patent of addition, No. 16,009/09, relates to a modified manner of dividing, raising and supporting the pairs of warps in the knot stitch carpet loom indicated above and described in the main patent.

Both patents would normally have expired during the present summer, and some years ago they were assigned to a certain firm of which the inventors apparently were not members. It is not usual for extensions of patents to be readily granted in cases in which the inventors cannot be shown to have a direct benefit by the extension, so that the present application of which the legal part is to be found in the ordinary official reports, is of direct interest to those proprietors of patents not being inventors who desire to obtain extensions of their patents under the existing regulations.

The assignees in the present case based their ground on loss due to hostilities, and evidence was given proving that orders for the looms had been placed with the firm of machinery manufacturers, but owing to these works being controlled the delivery of the patented looms was considerably delayed. Two only were delivered in 1914, two in 1915, and thereafter deliveries were suspended until the autumn of 1919. It appeared probable that the remaining looms could not be delivered until next year. It was shown that prior to the war the applicants had incurred several thousands of pounds expenditure on plant in connection with the patents, that practically the whole of the partners in the firm were engaged on active war service so far as possible, and that from 1915 onwards the applicant firm had been employed in the manufacture of munitions.

An extension of four and a-half years was asked for, the Comptroller-General agreeing to four years. In these circumstances it was definitely settled that each of the patents should be extended for four years.

THE DIESEL ENGINE USERS' ASSOCIATION.

Although the membership of the Diesel Engine Users' Association is mainly confined to the actual users of Diesel and semi-Diesel oil engines and to those associated with the management and care of such installations on land, engineers of motor ships are eligible for membership, and it was therefore fitting that at the last meeting of the Association a paper dealing with some of the problems of the large marine Diesel engine should have been presented.

In his paper on "Marine Diesel Engines," Mr. H. F. P. Purday gives a brief general survey of most of the existing types of marine engine, and discusses such questions as rating, the relative merits of the four-stroke and two-stroke cycles, and the injection of the fuel by solid and air injection. In dealing with thermal considerations, examples of cylinder cover construction are given, and curves illustrating the relation between liner thickness and pressure and temperature stresses are reproduced. Taking as a basis the weight of six-cylinder two-stroke cycle Sulzer marine engines, a graph is shown from which the author deduces the probable weight of a six-cylinder, 16,000 brake horse-power engine, which is estimated at about 2200 tons, a figure which is practically the same as the combined weight of reciprocating steam engines and boilers for a similar power. Assuming a stroke bore ratio of 1.5, the dimensions of a cylinder unit are given as 53in. bore and a stroke of 80in., the speed assumed being 71 revolutions per minute. Drawings showing the comparative sizes of reciprocating parts for steam and Diesel machinery are given by the author. The paper was followed by a full discussion, during which further information concerning the claims and the economy of the Still engine was communicated, and test figures were submitted showing results obtained with the Nobel marine engine when working with and without supercharge. With regard to the Sulzer type of engine it was pointed out that, while the graph connecting the relation between weight and brake horse-power was fairly representative of the six-cylinder two-stroke cycle engine for sizes beyond, say, 5500 brake horse-power, eight cylinders would be preferable and would enable a reduction in weight to be obtained.

In replying to the discussion, Mr. Purday remarked that it seemed quite a difficult matter to get reliable first-hand information concerning the running of marine Diesel engines and details of sea-going experience. If, he urged, in turning its attention to marine matters the Association was able to do something to remedy this deficiency, its work would be of considerable value both to marine Diesel engine builders and those who own and operate motor ships.

An outstanding feature of the papers which from the beginning have been read before the Diesel Engine Users' Association, has been their practical and experimental value and the way in which they have brought together the engine builder and user in the common endeavour to solve the problems at issue. Important contributions have been made on the subjects of fuel oils, lubricating oils, and the wear and running of land installations, and progress has undoubtedly been made.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Holidays.

The engineering and iron and steel works of the Black Country and the Midlands have been idle during the whole of this week on account of the August holidays, and only in exceptional cases have works been in operation. In many cases a resumption will be made on thin order books, but in isolated cases it is possible to find firms quite busy, especially the re-rollers, some of whom, for several weeks, have been working up to three-fourths of their capacity. The iron and steel market at Birmingham to-day (Thursday) was sparsely attended, and although business is still a good deal upset by the vacation and currency fluctuations, the tone is hopeful. Nevertheless, with a general slack month ahead, it appears improbable that there will be much movement until the beginning of the autumn.

Local Ironmasters' Disadvantage Removed.

The announcement by the Midland Iron and Steel Wages Board, recorded by me in last week's letter, of a reduction of 5 per cent. in ironworkers' wages as the result of the ascertainment of selling prices for May and June will prove to be very helpful to local ironmasters, for simultaneously with this declaration the Northern Board announces a wage advance of 2½ per cent. It will be remembered that in February last the Staffordshire ironmaster strongly complained that he was paying 12½ per cent. more in wages than his northern competitor. Two months ago the difference was reduced to 5 per cent., and the Staffordshire manufacturer now gets an advantage of 2½ per cent. The disadvantage under which he laboured during the spring thus passes, to a small extent, to his competitor. The matter has thus automatically adjusted itself, and the special committee formed some months ago to deal with it will presumably find its occupation gone. It is generally agreed that any advantage of this kind should be in the hands of South Staffordshire, in view of the permanent obstacle to business arising from expensive railway rates.

The "Cut" in Steel Prices.

The cut in steel prices by the Scotch and other northern makers as the result of the freeing of the market affects consumers in this part of the kingdom much more than steel makers. The Midlands and Staffordshire are not producers of steel boiler plates, and even in the matter of sections their output is not large. Construction engineers here, however, welcome the drop of 10s. per ton which, it is understood, has already taken place in tees and angles, as a means to enable them the better to compete for export orders, and it is fairly certain that the fall will also apply to bridge and girder plates. Angles now become £9 and tees £10 per ton, and bridge and tank plates £9 10s. to £10. Further early reductions are looked for by buyers since the removal of control and the throwing open of the Scotch trade to competition among makers must certainly lead to more price cutting ahead. The new prices for boiler plates, which are reduced £1 per ton, are £12 for home and £11 for export. Steel generally has a poor tone still, and the outlook is none too bright, although there are a few more inquiries abroad. Prices are still being cut very finely. In the half-product market a little more movement is observable, but finished bars continue to be out of demand. That coal was largely the root of the trouble was the opinion expressed by a prominent member of the trade, who declared there was little hope of any benefit from fuel prices until the output of coal per man was increased. Makers of steel wire are better employed, having received substantial orders for the colonial markets, presumably diverted from America owing to labour troubles there. Home prices for steel semis are still quoted £7 5s. to £7 7s. 6d. Steel strip for tube making can be bought for £10. Foreign competition in steel is relaxed a little, chiefly because France and Belgium now find a more profitable market in Germany, where the steel works are quite unable to obtain sufficient fuel to keep in full employment, and are taking advantage to an increasing extent of semi-finished steel from their late enemies.

Pig Iron Firmness.

The pig iron market shows no material change. Most of the few furnaces in operation manage to dispose of their output, and the position has improved a little owing to the better demand for forge iron. The renewed buying of this material is a hopeful feature, as only a few weeks ago this iron was practically unsaleable. The recovery of the foundry branch is disappointingly slow, sales seldom exceeding 25-ton lots. While prices are firm, largely on account of a rise of 2s. 6d. in Welsh and Yorkshire coke, an indirect result of the heavy shipments of coal to America, Midland values are firmer. This in itself suffices to give firmness to pig and is possibly accountable for a little increased buying. The price of Derbyshire No. 3 foundry at furnaces is 82s. 6d., and in a few cases 85s., and of Northamptonshire foundry 80s. Following the example of other departments, the West Coast pig iron makers have decided to de-control prices. A few orders have come from customers who have been off the market for many months, and the urgent appeals for prompt delivery suggest that stocks at the works are pretty well exhausted. Northampton smelters will benefit a little from the reopening of the Scotch market after the holidays, and in competition with Cleveland they still have an advantage of a few shillings per ton. The re-starting of Scotland, however, has been very partial, the steel trade revival being slow and spasmodic, in the absence of a strong shipbuilding demand. The only competition in pig iron appears to originate with Luxembourg, which is severely underselling certain Midland houses in the Scotch market. Some falling off in pig iron exports is generally attributed to the collapse of continental currencies, Germany having almost disappeared as a buyer.

Manufactured Iron.

Ironmasters generally report themselves rather better supplied with business, and a few re-rolling works are operating to nearly three-fourths of their capacity. Finished iron orders are more satisfactory, but prices continue to weaken, and customers are already pressing for the equivalent of the wages reduction. Marked bars are maintained at £13 10s., but merchant qualities and the commoner grades continue to fluctuate and to be quoted differently by almost every maker. For nut and bolt iron the level is about £9 17s. 6d., and though one or two firms adhere to the £10 quotation other South Staffordshire makers are willing to accept £9 12s. 6d., and in some cases even as low as £9 10s. Very low quotations are heard of for Belgian iron, but with the present uncertainty of the exchanges it is doubtful whether much fresh business is going abroad, though a good many orders recently left the Black Country at £8 12s. 6d. and slightly under. Iron strip is round about £11. Representatives of the Lancashire houses report a very good business in cotton baling hoops for Egypt and India. A strong effort to get a share of this business for South Staffordshire has not hitherto been successful.

Galvanised Sheet Prices.

Galvanised sheets are rather firmer, largely on account of the substantial increase in spelter values, combined with some improvement in demand. The local mills which specialise on thinner gauges find themselves well able to compete with South Wales. One or two firms quote as high as £16 6s. f.o.b. for 24-gauge corrugateds, but by general consent this is regarded as too high. Others claim to be getting £16 2s. 6d., and purchases can be made at £16. Ordinary black sheets command £12 at works and annealed £14.

Unemployment in West Midlands.

A steady decline, for various reasons, including the depression in the Black Country in the tube trade and, in a lesser degree, in the motor and subsidiary industries, in the number of unemployed in the West Midlands area has been arrested. The current returns show a very slight increase—500—over the total of a week previous. On July 31st the grand total was 177,121. In the Birmingham area the total was 62,877, and next in order came Wolverhampton, with 9670; Smethwick, with 8116; Walsall, with 8101; Cradley Heath, with 7228; and Coventry, with 6922.

LANCASHIRE.

(From our own Correspondents.)

Manchester, Thursday.

Iron, Steel and Metals.

The markets in the Manchester district are very quiet, not to say dull, and business all round is on an extremely small scale. There is very little opportunity now for successful merchant operations, as buyers continue their policy of hand-to-mouth purchases, and there is practically no forward buying. Hence the chance of skilful anticipation of market changes is very seldom afforded, and the merchant has to pick up a precarious living as best he may. The restoration of some degree of confidence in the market is delayed, and there are now quite a number of people who think that it cannot come for a very long time. The rapid downward movement in prices is, of course, over, but the slow downward movement has to succeed if former experience is to be any guide. In the boom of the 'seventies—which, of course, few people alive can now remember—the rapid movement lasted for about a year, and the slow movement for over four years. In the iron and steel markets there are two main points of general interest, viz., the American demand and the extension of the abandonment of the control of prices by the Associations. Apparently this control is merely suspended temporarily, but it is quite possible that the suspension may eventually lead to the break-up of the Associations. The return to absolute individual freedom would, of course, be welcome to the merchant trade.

Metals.

The movement in the standard copper market has continued, and has brought the price of standard to within a very short distance of the prices for refined ingot, except electrolytic. In fact, during the latter part of last week some tough ingot copper was sold in this district at scarcely anything more than the standard price. There is, however, a tendency just now to hold out for higher prices, and some merchants will not take orders for refined unless at about £5 per ton above the standard price. There seems to be a disposition, much stronger than it was, to treat standard copper as a good investment, with the result that as warrants are taken up they do not again come upon the market; and, of course, if this goes on there will be a scarcity of warrants; while, if the consumptive demand does not increase, the refined sorts will be comparatively plentiful. We have before seen a position similar to that which seems to be developing, where refined ingots were tendered against contracts for standard. In the end this may mean dearer refined copper, and probably those consumers who still have the opportunity of buying best select ingots at the price of standard may do well to secure a moderate stock. At any rate, little can be lost now by buying ingot copper in good time. It is noticeable that the dealers in scrap are offering more for clean old copper, some going up as high as £56 per ton. Not so long ago they would not pay more than £50. In the market for tin, professional opinion seems to be favourable, but here merchants are still rather sceptical. Probably one reason for this divergence of opinion is that merchants

in Lancashire are more influenced by the state of demand for tin in the engineering trades, for, of course, the tin-plate trade demand does not come their way, and the engineering demand in Lancashire is very poor. Hence one must not put too much reliance in opinion here. In London a further advance seems expected. Lead has been fairly active, but the prices do not respond, and one is inclined to think that they have reached the limit. Of course, this does not mean that any collapse is near at hand, but merely that hand-to-mouth buying is fairly safe. Spelter has been a very strong market, and there seems to be every reason for supposing that the recent advances have not exhausted all the possibilities of the position. A favourable view of spelter has been taken by a good many people for a long time, and the wonder is, not that prices are going up, but that they did not advance much sooner.

Pig Iron.

The position in the Lancashire district as regards pig iron is uncertain, but so far as common No. 3 iron is concerned there seems to be no expectation of any fall. Sellers continue to quote 91s. per ton for ordinary No. 3 foundry pig, but the demand for it here seems to be less than it was, and the market has rather a feeble appearance. Ironfounders are not buying freely, and it is said that they do not find many orders for castings. There is a report that the Scottish ironmasters propose to raise the price of Scotch No. 3, having been put in a stronger position by the sales to America; but if so it is to be feared that business in Scotch iron here will languish. The Lancashire ironfounder naturally thinks that Scottish iron prices are already excessive as compared with common iron, and besides this he can buy hematite pig iron both from the West Coast and from Cleveland at considerably less than the present price of Scotch iron in Manchester. Certain Lancashire foundries are so thoroughly accustomed to the use of Scotch iron that it will be difficult to make a change, but their patience should not be tried too far.

Finished Steel.

There is some uncertainty here about the prices for finished steel, and as the orders coming to hand are only for small quantities it is difficult to test the market, but probably the basis price for steel sections would be £9 per ton. As for extras, these are supposed still to be controlled; that is, the makers are under obligation to use the old list, but one doubts whether this obligation will be regarded, at any rate after a time.

Scrap.

The market for scrap of all kinds is quiet and without any quotable change. Here dealers in special qualities of foundry scrap hope to be able to get rather higher prices if there be any general revolt against paying the price for Scotch pig iron. Ordinary foundry scrap is quiet at £4, and sometimes down to £3 17s. 6d. per ton.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is a better tone altogether in the hematite pig iron trade, and there appears to be more confidence all round. The number of inquiries from various sources is large, and one maker remarked recently that if all the inquiries resulted in orders there would be no lack of work for all. It is well not to take too optimistic a view, but certainly the signs are much better. Quite apart from ordinary customers at home, who as soon as they get to work properly will be ordering in heavier quantities than they have done for some time, there is an expansion in the continental trade. Pig iron was shipped last week from Barrow to Antwerp and Tréport, and there was a further dispatch of ingot moulds by sea to South Wales. There is no sign of more furnaces going in, but as soon as present stocks are reduced this will happen. The steel works are taking a fair quantity of iron smelted in the district.

Iron Ore.

There is very little improvement in the native ore trade, but it will get better as soon as more furnaces are put into blast. There was a part shipment of native ore for Tréport last week from Barrow. There arrived another cargo of Spanish ore from La Falaises. Foreign ore will be required in larger quantities as soon as the trade increases.

Steel.

There is a better tone in the steel trade and orders have been booked which will mean steady work for some weeks. Some of these orders have to do with rails for India. Both the Barrow works and the West Cumberland steel works are again active. At the latter business is practically confined to railway material, but at Barrow the rail, merchants and hoop mills are at work. There has been a further order for hoops from America, and it had to be rushed to allow of export at an early date. The coal strike in America has resulted in much work being given to the Barrow hoop mills. During last week there were several cargoes of rails sent to Liverpool for transshipment, and also a cargo of rails and fish-plates for Alexandria.

SHEFFIELD.

(From our own Correspondent.)

More Interruptions.

SHEFFIELD seems to be particularly ill-fated in respect to the repeatedly postponed trade revival. No sooner is one obstacle overcome than another blocks the way. Certainly no considerable orders had been received, but the aggregate of a steadily increasing volume of comparatively small orders was reaching appreciable proportions, and last week's reduction in the total number of unemployed dropped by 5000 or 6000 to something like 37,000. This week, however, by a combination of circumstances, the east-end has reverted to the condition of quietude that characterised it for the greater part of the early summer. This is, of course, in part due to the holiday. Many of the works have shut down for the week, though nothing like the number that took similar advantage of the Easter and Whitsun holiday break. In the majority of cases this time, the holiday extended to only two or three days, but thanks to a twenty-seven hours' continuous downpour of rain on Monday, many of the works in the lower parts of the city were found to be so flooded when the men returned on Tuesday morning, that a restart that day was out of the question. Well over 4in. of rain fell in that period, and owing to the fact that the districts in which many of the works are situated are surrounded by hills, the water accumulated in and around these works to a depth of several feet. As far as can be ascertained at the time of writing, no very great material damage has resulted, and it is only a matter of a few hours or a day or so at most before the water will have sufficiently subsided to enable work to be resumed; but even this stoppage is extremely discouraging at a time when everyone was hoping that a period of steady employment had arrived.

Abortive Conference on Bonus Cuts.

Settled conditions have by no means been reached in connection with the operation of the cuts in the war bonus of men employed in the forges and rolling mills. A prolonged conference took place last week-end between the Sheffield Engineering Employers' Association and the representatives of the trade unions affected, but no agreement was arrived at. The men's representatives, it is understood, were anxious to have the points at issue referred to arbitration, but there was difficulty in arriving at an understanding as to terms of reference.

Corporation's £200,000 Scheme.

With the prospect of unsettled conditions continuing in the local trades, and the consequent maintenance of the unemployed figures at the present high level the local authorities have been preparing a number of schemes with a view to providing emergency work which will be of a permanently useful character. These schemes include the clearing of filter beds, road-making and road improvements. At present there is provision for the employment of something like 1600 men for six months, at a cost of about £200,000. Such schemes are, however, only palliatives, and scarcely touch the fringe of the problem presented by the existence of nearly 40,000 men idle for month after month. Nothing short of a wholesale reopening of the great steel and engineering works will meet the urgent necessitites of the case, and unfortunately this general resumption of activity seems as far off as ever. If only the railway companies could be persuaded to place some big orders for the renewals they must stand in urgent need of, this would materially help. Hopes were centred in the early commencement of work on the two new battleships, but local Members of Parliament have been unable to obtain any assurance that this work will be expedited, while it is said that much of the preliminary work which was in hand for the Admiralty before the Washington Agreement occasioned the curtailment and suspension of this country's naval programme, will be utilised in the new vessels when these are proceeded with, so that the prospects of any considerable relief from this source are largely discounted.

Living in Hope.

Meantime, while Sheffield has the melancholy knowledge that in the matter of trade revival, it lags behind most other industrial centres, it has to be sustained with the assurance that better times cannot be indefinitely delayed. There is, as its manufacturers have so often been told, a world shortage of steel, and not all the efforts of its rivals, either on the Continent or in the ambitious Overseas Dominions or even America, seem able to wrest from Sheffield its supremacy for steel of the highest quality. Such steel will be wanted in connection with the great electrical enterprises and railway developments which are in preparation all over the world. Unfortunately, no tangible signs of this promised prosperity are yet to hand, and the position of not a few local firms is becoming increasingly acute. It is not surprising therefore to learn that a good deal of price cutting is being practised. In fact, it had become so prevalent that it was no longer possible to make any attempt to maintain the official minimum, and last week-end brought the announcement that in various parts of the country a "free market" was to be observed in steel manufactures. It would, however, be futile to hold out hope that as a result there will be any very considerable cuts, because, despite all official disclaimer and discouragement, the fact remains that for some time past the agreed minimum rates had been honoured more in the breach than in the observance. Quite a number of firms, it is true, had strictly observed their Association's agreement, but they were well aware that rivals were ruthlessly cutting rates in a desperate attempt to keep their heads above water. It is, of course, much more satisfactory that the "free market" should be officially recognised.

Fuel and Alloys.

Local collieries have already felt the effects of the American stoppage, and full time is being much more commonly observed. Although there was only a moderate attendance at the Sheffield week-end coal exchange, there was a marked improvement in the demand for industrial fuels. Best steam hards were a fairly good market, especially for export business, while home consumers were taking supplies that indicated increasing confidence in the early revival of trade. The railway companies are still building up their reserve stocks and have been considerable buyers. Slacks are still on the scarce side, and prices keep firm. Furnace and foundry coke continue to experience a steady demand. Metal and alloy markets are waiting a real revival in the engineering trades. Tungsten has maintained its recent rise, but is still very cheap, and another advance may be expected. Ferro-silicon is practically without change, and ferro-chromes have also moved very little. Some improvement is reported in nickel, cobalt and aluminium, and there are some signs of shortage in ferro-manganese, in connection with which the new United States tariff is causing some uncertainty, as considerable changes are proposed in the duties on material containing manganese.

Steel Manufacturer's Death.

The death has occurred of Mr. John Benjamin Tompkin, governing director of Flockton, Tompkin and Co., Limited, Newhall Steel Works, the well-known makers of tool steels. Mr. Tompkin was seventy-five years of age, and had been in failing health for some time. He came of an old Sheffield family, and devoted his life almost exclusively to the study of steel manufacture and the development of his firm, combining considerable technical and scientific skill with marked business ability.

NORTH OF ENGLAND.

(From our own Correspondent.)

Quiet Trade Position.

As is usual in August Bank Holiday week, business in most trade sections is temporarily held up, and the markets present a very quiet appearance. There is a general feeling that the trade tide is now on the turn, and that a gradual, though slow, improvement will be experienced. The iron and steel trade is still seriously handicapped by the excessive railway rates. A revival appears to be largely dependent upon further reductions in rail charges, and it is hinted that it may be necessary to ask the railway companies to carry raw materials at something less than a commercial rate for a period.

Cleveland Iron Trade.

Apathy still characterises the Cleveland iron trade. There is very little business passing, and any considerable improvement is now hardly to be expected until the August holiday period is over. A few more inquiries are reported from the United States for ordinary qualities of Cleveland iron. There have been some fair shipments of special foundry iron to America; but, with the exception of a couple of cargoes shipped some weeks ago, there have been no sales of ordinary qualities in this direction. It would appear that there is some probability of further developments, but everything, of course, depends upon the view taken in the States of the possible duration of the coal and transport strikes there. Anything like a substantial demand from across the Atlantic would completely alter the present trade position on the basis of existing output. In the meantime the export position remains very quiet. The further decline of the mark, with its effect on the exchanges generally, pretty effectually eliminates inquiry from abroad, and until something can be done in the direction of stablising the continental currencies it is obvious that Cleveland's pig iron export trade must continue to languish. Home business, too, has shrunk to very small proportions. Scottish consumers are taking only trifling quantities of Cleveland iron, the products of other districts, owing to their comparative cheapness, capturing most of the trade north of the Tweed. The scarcity of No. 1 and siliceous iron is as pronounced as ever, and consequently quotations are firmly maintained at 95s., but other descriptions are in ample supply and values tend downwards. No. 3 G.M.B. is 87s. 6d.; No. 4 foundry, 87s.; No. 4 forge, 85s.; and mottled and white iron, each 80s. All the foregoing quotations are f.o.t. maker's works or f.o.b. Tees.

Hematite Pig Iron.

The situation as regards hematite pig iron is far from satisfactory. The output is considerably in excess of current requirements, with the result that the already somewhat large stocks at makers' works are steadily increasing. Under such conditions it is not surprising to find prices distinctly easy. The producers' decision this week to remove the last remaining price restriction by the discontinuance of the practice of an agreed or fixed minimum price has not as yet opened out the market to any extent, but now that individual negotiations determine market values there is keen competition for orders at cut prices. Mixed numbers for home use are generally quoted at 91s. 6d., but business is possible at from 6d. to 1s. per ton less. The export price of mixed numbers may now be put at 90s. 6d.

Iron-making Materials.

Imports of foreign ore under running contracts continue on a fairly large scale, but there is practically no new business passing. Best Rubio remains quite nominal at 25s. per ton c.i.f. Tees. Coke is steady and rather firmer, good average furnace descriptions standing at 27s. per ton delivered at the works.

Manufactured Iron and Steel.

There are indications of improvement in the manufactured iron and steel trade, and there is a general feeling that a pronounced upward turn will be experienced in the near future. A gratifying feature is the renewal of interest, though as yet very limited, in shipyard material. A few orders have been placed during the past week, and more are expected to come forward. The arrangement by which manufacturers sold at the same price for home consumption has been dropped in the steel trade. In consequence of the holidays, and in the absence of business it is difficult to gauge the market. It is not expected, however, that quotations will fall at the outset more than about 20s. per ton.

The Shipbuilding Trade.

The shipbuilding trade, which has been in a parlous state for some considerable time past, is showing some signs of life. A few inquiries for new tonnage are

reported, and this week the Palmer Shipbuilding Company has booked an order for a special type of cargo vessel of 7000 tons deadweight for London owners. Accommodation will also be provided for passengers. The vessel will be fitted with twin-screw engines, which will also be constructed by the Palmer Company. In addition to this order the firm has secured contracts for the machinery for two oil tankers to be built on the Wear. The new vessel will probably be laid down in the Jarrow yard at an early date.

The Coal Trade.

The Northern coal trade position is in some respects irregular. There is still the same vexatious and exasperating trouble and congestion at the staiths and docks, causing detention to steamers, and resulting in no end of dislocation and in some cases loss of time at the pits, despite the fact that the coals are sold, for the simple reason that the scarcity of wagons and trucks prevents the collieries from clearing their output, and entails closing down for a day or so. A few more new inquiries are in circulation for the United States, but they are not for very large quantities, and the placing of them is not likely to affect the market in any noticeable way. The ideas of coal exporters as regards the prospects of further substantial business from the States are exceedingly varied and contradictory. Some apparently are of the opinion that the strike troubles will soon disappear and immediately after that the exports to America will die down and the whole business will "fizzle out" in a very short time. Others, however, are of opinion that in any case the Americans will be compelled to rely on supplies from Europe for a long while even after the strike is settled in order to keep the industries moving, and thus they regard the outlook for the coal trade here as being very satisfactory for the rest of the year. In any case, there are a number of contracts placed which will ensure shipments for some time to come. The inquiries from France are coming forward in larger volume, but the Italian demand is only moderate. The tone of the market is very strong, as may be tested by the offer of new business up to the end of the year, for which class of trade the present range of quotations is firmly indicated. It is reported in this connection that a contract has been placed through merchants for 20,000 to 30,000 tons of Durham screened steams for shipment from August to December at 25s. per ton f.o.b., which is regarded as a very good price, and much above what would have been thought possible a few weeks ago. For any class of best or second screened steams the position is firm, while for smalls famine prices are asked, in some cases up to 20s. per ton. Gas coals are remarkably firm, and so far as can be gauged 25s. is the lowest possible for any prime or special brand. Second gas, coking and bunkers are all in good inquiry for both August and September, except for odd cargoes on offer for spot at a discount. The coke position is also steadily maintained. The demand is good and prices are steady.

SCOTLAND.

(From our own Correspondent.)

Moderate Activity.

Markets have been very slow since the holidays' but during the past week or so conditions have assumed a more normal appearance. The majority of the works are again in action, though the volume of business passing is still far from satisfactory. It is commonly held that local prices are largely responsible for the meagre home demand. Consumers are persuaded that costs must sooner or later be considerably lower, and are prepared to hold back purchases unless for absolute necessities. On the other hand, the export inquiries are broadening out in almost all directions, and already orders are beginning to materialise. Producers are quoting more reasonable prices for shipment, and in the near future are likely to make still further concessions. The position of the shipbuilding industry is most unsatisfactory. Orders for new tonnage are few and far between, and many berths are empty. The effect on the steel trade is far-reaching, and increased activity at the shipbuilding yards would be very welcome.

Pig Iron.

The home demand for pig iron leaves small room for satisfaction. There is practically nothing being done in hematite, and no increase can be looked for until there is more life at the steel works. A number of inquiries are passing for foundry qualities, but orders are on the small side. It is said that continental pig iron is being brought from the Midlands to Scotland. A fair inquiry on American account is also reported, but this is chiefly concerned with ferro-manganese. The Glasgow pig iron ring continues its weekly meetings, but buyers are still absent.

Steel Materials Moving Slowly.

Most of the steel works are in operation, though only on a moderate scale. Orders for plates are exceedingly scarce, but the recent reduction in prices may help matters. Sectional material is a little more in demand. Steel sheets have improved somewhat of late, but, as in other branches of industry, the growth is almost entirely in an export direction. Sheets of the lighter gauges have met with some good inquiries for shipment. Galvanised sheets, too, are also in better request, and prices are firmer.

Bar Iron Improving Slightly.

Although there has been nothing approaching substantial improvement, the bar iron works have some fairly good orders on hand. Local consumers are busier, and this must eventually affect the malleable works also. Home prices are unchanged, but export figures are now about £10 per ton basis. The steel branch of the industry is improving, some good inquiries being in circulation for re-rolled bars for ferro-concrete work.

Scrap Hanging Fire.

Few inquiries are mentioned in connection with scrap material, and the activity noticeable before the holidays has not been resumed so far. This is held to be only a temporary relapse, and prices are firmly maintained.

Coal.

The American situation has affected all branches of the Scotch coal trade, principally in respect to prices. The amount of business done has been small so far, but quotations have firmed considerably. Round coal is therefore in rather a fictitious position. The market is firmer, but the demand is still remarkably poor. The immediate result has been to make home orders even smaller than formerly, if that were possible. Household fuel, too, is dearer in sympathy with the rise in other descriptions. The turnover in washed nuts, especially for shipment to Germany, is fully maintained, and the collieries, more particularly in the Lothians and Fifeshire, are heavily engaged. At Methil and Leith a number of steamers await their loading turn. Prices generally are unsettled. The aggregate shipments for the past week amounted to 298,070 tons, compared with 288,548 tons in the preceding week, and 214,041 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

The holidays have made it rather difficult to gauge the position with accuracy, but from the known factors there is every indication that the coal trade during the remainder of this month, and, indeed, for the early part of September, will be very firm. It is true that the American demands have so far been for the superior grades, and as it is doubtful whether they can get any more of them for fairly early loading, it naturally follows that if they desire to arrange for substantially increased quantities it must be for lower quality coals. As a matter of fact, the latter have already firmed up in sympathy with the best descriptions. The early part of last week saw quite a lull in the inquiry for coals for American account, but before the week was out it was evident that the demand both from America and Canada was very insistent and pressing. The chief question is, however, whether the Americans will now pay the much higher prices that are asked for supplies as compared with the figures at which they secured the first half a million tons. There is evidently a reluctance on their part to concede the prices ruling, but so far as can be seen it is difficult to see how they can hope to get coals on a cheaper basis, as the conditions prevailing in other exporting districts of this country are very firm. Furthermore, it is not only a question of the price of the coals; exporters in most cases have to take the risk of the freight, and it is only natural that they should act with considerable caution considering the last experience they had. The rate of freight now for North American ports is approximately 12s. to 12s. 6d., but it will be remembered that when the American business opened exporters based on round about 7s. 6d., and before many of them had chartered anything like the quantity of tonnage they required the rate went to as high as 16s., which meant that a number of the firms must have been badly caught. There is no doubt that the position of both America and Canada is pretty serious from the point of view of the need for large supplies of fuel, and even assuming that the strike of the miners in America should terminate at an early date, it is expected that they will require to import supplies for some time. Up to the end of last week tonnage had been chartered on the open market to lift rather more than 650,000 tons of coal, and there are still orders which have to be executed and for which tonnage has to be taken up. Apart from steam coals the call for anthracite is fairly substantial, but collieries have very little to offer, as they are already very fully booked up for the remainder of this month and the early part of next, and prices are very firm.

Coalowners Criticised.

One of the most unfortunate features of the present improved state of affairs in the coal market is that the miners do not benefit in any way from the wage point of view, and that it will be some months before they do, assuming that the existing conditions continue to hold good. The bulk of the coals sold to America so far have been disposed of at very low prices, and it was following upon the closing of large orders for the States that prices rose. Furthermore, the orders for America were for the superior classes of coals, and business for the other grades has been comparatively quiet, although it is expanding. The aggregate of business done for Transatlantic shipment at the moment represents little more than half a week's normal output from the whole of the South Wales coalfield, and therefore it will be seen that operations generally will have to increase considerably before anything in the nature of a real boom is experienced. Some of the miners' leaders recognise the situation from the men's wage point of view, and are now criticising the coalowners for selling their coals at so low a figure. They contend that the American demand should have been foreseen, and talk glibly of the coalowners having been caught by the clever Americans. They hold that the present methods of disposing of coal are not the best in the interests of the industry generally, and that if the miners' advice regarding control of prices had been listened to the American coup would have been impossible. At the same time other leaders are saying that coals should not be allowed to be exported to America for the purpose of breaking the strike of the miners there. It is very doubtful whether any scheme could be devised to make the Americans any more than any one else pay more than the current value of coals. The action of the Americans was not novel; they sent out inquiries for supplies and accepted practically all the offers they received, so that in the aggregate the quantity was fairly substantial, and the colliery companies which had given quotations to the coal-exporting firms on which they based their offers, confirmed those quotations, as they were in honour bound to do. At the time the offers were made the coal trade was in a very bad way, and collieries were crying out for orders to keep their pits going. If by combined action on the part of the coalowners it was decided to quote for American inquiries 30s. per ton for large as against 24s. to 24s. 6d., which was then ruling, the chances are that the whole of the business would have gone to other exporting districts, in which event the labour leaders would have been loud in their condemnation of the methods of the employers, and they would have said that it was done with a complete disregard to the interests of the workmen, who would have continued to be very irregularly employed.

Miners' Wages.

The certificate of the joint accountants of the South Wales coal trade, giving the proceeds and costs in the month of June, shows that for the first time under the present agreement there is a deficit which will be carried forward and deducted from any future surplus. In order to secure to the miners the unbroken continuance of the minimum wage, the coalowners will be called upon to sacrifice not only the whole of the standard profits of £283,272, which it was originally contemplated they should receive coincidentally with the payment of the standard wage, but an additional loss of £106,594. Of this amount a sum of £56,480 represents the actual deficit in June. That amount will be carried forward as a charge against future surpluses, but the irrecoverable loss of the coalowners in respect of the trading results of June will amount to the phenomenally high figure of £333,386. This brings the total amount sacrified directly by the coalowners since last November to £1,984,000. The real loss to the owners is, however, greater. This sum is irrespective of the share of the surpluses of the industry which the owners would have retained if the industry had been on an economic basis. In that event they would have been entitled to 17 per cent. of such surpluses, and the loss from this source amounts to a further sum of £585,000, which, added to £1,984,000, brings the real loss of the owners to £2,569,000, but over the whole of that period the miners have been guaranteed employment at the minimum wage.

Current Business.

The conditions on the coal market are very unsettled, and are likely to remain so for the whole of this week at least. Seeing that there was no work in the coalfield for the first three days of the week, it was expected that supplies of the superior grades would be scarce, and owners preferred to be in a better position to gauge the situation before quoting for further business. Many of the collieries producing the best coals are practically out of the market, as they are fully booked up, and others are holding off in anticipation of being able to get good prices. Very heavy pressure will be experienced at the docks for the next few weeks, and there is no doubt that the question of adequate loading berths will be very much to the fore. Although so far European consumers have not shown any great readiness to come along and buy at the much higher prices now ruling, still there are better prospects of busines materialising later. The French State Railways, which were in the market for 10,000 tons of Cardiff or Newport small coals for delivery within a month from the closing of the order are not purchasing, this being doubtless on account of the high prices tendered. Nominally market prices are approximately those given last week.

Coal Inquiries.

Over the holidays coalowners and exporters received numerous inquiries from America and Canada for supplies of steam and anthracite coals for delivery at the end of this month, during September, and even later shipment. A considerable amount of business, running, it is said, to several hundred thousand tons, is reported to have been done, but this is difficult as yet to confirm. Orders for 100,000 tons of steam coals for Canada are said to be definitely concluded. The demand for anthracite sized coals for America and Canada is heavy, and the market promises to be very strong.

Swansea Metal Exchange.

Owing to this being holiday week in the tin-plate trade there were no regular quotations this week, but tin-plates were firm on the basis of 19s. 6d. to 19s. 9d. per box, as the holidays will mean a material reduction in stocks.

Fuel Works.

The Atlantic Patent Fuel Works (Nos. 1 and 2) at North Dock, Swansea, have been purchased by the Reliance Patent Fuel Company, of Llanelly.

LAUNCHES AND TRIAL TRIPS.

San Roberto, single-screw steel tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Limited; to the order of the Eagle Oil Transport Company, Limited; dimensions, length overall 420ft. 6in., length between perpendiculars 407ft., breadth moulded 52ft., depth moulded to upper deck 31ft. 6in.; to carry 8250 tons on a mean draught of 25ft. 3½in. Engines, triple-expansion, 27in., 45in. and 75in. by 48in. stroke, pressure 180 lb.; constructed by the Wallsend Slipway and Engineering Company, Limited; launch, July 25th, 1922.

Unveiling a Roll of Honour.—The unveiling of the roll of honour in memory of the members of Metropolitan-Vickers Approved Society who fell in the war took place on Wednesday, the 2nd inst., in the workmen's canteen of the company's Trafford Park works. In the course of his remarks, the chairman, Mr. R. W. Rowe, mentioned that during the period of the war, out of a total male membership of 2301 covering that whole period, 924 men joined the colours. Out of this large number 74 men failed to return, and, he added, it was to their memory that this tribute of regard was to be paid. On behalf of the members of the society, and in memory of the dead whose names appeared on the roll of honour, he therefore requested Captain Hilton, managing director of the company and president of the society, to unveil the memorial.

Current Prices for Metals and Fuels.

IRON ORE.

N W. Coast—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. Coast—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 8 9	—
No. 1 Foundry	4 17 6	—
No. 3 Foundry	4 12 6	—
N.E. Coast—		
Hematite Mixed Nos.	4 10 0	4 10 0
No. 1	4 10 6	4 10 6
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 7 0	4 7 0
No. 4 Foundry	4 5 0	4 5 0
No. 4 Forge	4 3 0	4 3 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 1 6	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 4 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. Coast—		
Crown Bars	11 0 0	—
Tees	10 10 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	11 0 0	—
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 0 0 to 11 5 0	
Hoops (Nom.)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	12 10 0	—
Ship Plates ¾in. and up	9 0 0	—
Sections	8 15 0	—
Steel Sheets ⅝in. to ¼in.	10 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 12 6

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 0 0	9 0 0
Angles	9 10 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	8 10 0
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
Manchester—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0 0	
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
Midlands—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 7 6	—
Hoops	11 10 0 to 12 0 0	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (24 W.G.)	11 15 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0	—
Angles	9 0 0	—
Joists	10 0 0	—
Tees	10 0 0	—
Bridge and Tank Plates	9 10 0 to 10 0 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	162 15 0
,, (three months)	162 15 0
Copper (cash)	64 12 6
,, (three months)	64 15 0
Spanish Lead (cash)	25 5 0
,, (three months)	24 10 0
Spelter (cash)	31 5 0
,, (three months)	30 17 6
Manchester—	
Copper, Best Selected Ingots	70 0 0
,, Electrolytic	72 0 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	27 0 0
,, Foreign	25 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£85	37/-
,, carbon free	1/1 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	24 10 0 scale 6/- per unit	
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb	
Aluminium (per ton)	£110 to £120 (British Official.)	

FUELS.

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/-
,, ,, Ell	24/-
,, ,, Splint	24/- to 27/-
,, ,, Trebles	24/6
,, ,, Doubles	21/6
,, ,, Singles	20/6
Ayrshire—	
(f.o.b. Ports)—Steam	23/-
,, ,, Splint	24/-
,, ,, Trebles	22/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	25/- to 26/-
Screened Navigation	28/-
Trebles	23/-
Doubles	22/-
Singles	20/6
Lothians—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/-
Trebles	23/-
Doubles	22/-
Singles	20/6
England.	
(8) N.W. Coast—	
Steams	33/-
Household	46/8 to 57/6
Coke	34/-
Northumberland—	
Best Steams	24/- to 25/-
Second Steams	22/6 to 23/-
Steam Smalls	17/- to 18/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/- to 25/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	33/- to 35/-
Sheffield—	Inland.
S. Yorks. Best Steam Hards	21/- to 22/- —
Derbyshire Hards	20/- to 21/- —
Seconds	18/- to 20/- —
Cobbles	17/- to 19/- —
Nuts	16/- to 18/- —
Washed Smalls	10/- to 11/- —
Best Hard Slacks	12/- to 13/- —
Seconds ,,	9/- to 10/6 —
Soft Nutty ,,	7/6 to 8/6 —
Pea ,,	7/- to 8/- —
Small ,,	2/- to 4/6 —
House, Branch	30/- to 33/- —
,, Best Silkstone	27/6 to 29/- —
Blast Furnace Coke (Inland and Export)	19/- to 21/-
Cardiff—	(9) South Wales.
Steam Coals:	
Best Smokeless Large	30/- to 32/6
Second ,, ,,	29/ to 30/-
Best Dry Large	29/- to 30/-
Ordinary Dry Large	25/- to 27/6
Best Black Vein Large	29/- to 30/-
Western Valley ,,	29/- to 30/-
Best Eastern Valley Large	27/6 to 30/-
Ordinary ,, ,,	25/- to 27/6
Best Steam Smalls	21/- to 22/6
Ordinary ,,	19/- to 21/-
Washed Nuts	25/- to 26/-
No. 3 Rhondda Large	29/- to 30/-
,, ,, Smalls	21/- to 23/-
No. 2 ,, Large	24/- to 26/-
,, ,, Through	21/- to 23/-
,, ,, Smalls	16/- to 17/6
Coke (export)	40/- to 42/6
Patent Fuel	26/- to 30/-
Pitwood (ex ship)	40/- to 42/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	55-/ to 57/6
Seconds	45/- to 50/-
Red Vein	35/- to 40/-
Machine-made Cobbles	67/6 to 70/-
Nuts	67/6 to 70/-
Beans	42/6 to 45/-
Peas	23/- to 25/-
Breaker Duff	8/- to 8/6
Rubbly Culm	14/6 to 15/6
Steam Coals:	
Large	21/6 to 25/-
Seconds	20/- to 22/-
Smalls	14/6 to 16/-
Cargo Through	19/6 to 20/6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export. (9) Per ton f.o.b.

NOTE.—Coal prices for export are still rising.

French Engineering Notes.

(From our Correspondent in Paris.)

Labour.

The agitation over the question of the eight hours' day is developing in a way that threatens to cause serious trouble in the early future. The Seamen's Federation and other unions are up in arms against any attempt at undermining the principle of the eight hours' day, and solemn resolutions have been passed to the effect that the "rights" of the men will be defended by general strikes. The Under-Secretary for the Merchant Marine, M. Rio, has prepared a Bill, which is to be introduced shortly into the Chamber of Deputies, for suppressing the eight hours' limitation in the marine until such time as it shall be adopted in the marines of other countries. The arguments in favour of the Bill are so unanswerable that there can be no doubt of its going through Parliament. The French marine is the only one in which the eight hours' day is observed, and apart from the impracticable character of the measure the limitation of working hours has increased the number of men on board ship, and has, it is said, burdened the shipowners with an additional charge of 177 million francs a year. The French Seamen's Federation is fighting the Bill, first, by endeavouring to obtain a universal application of the eight hours' day, for which purpose it made desperate attempts to get it adopted at the International Conference held in Paris last week, but the British delegates made it quite clear that under present circumstances the British seamen would not stand out for an eight hours' day. The French representatives expressed their feelings in no uncertain terms, and withdrew from the international union with the intention of organising a conference of their own. The same thing is taking place in the colliery industry. Coalowners declare that they cannot continue operations so long as the eight hours are fixed from bank to bank, whereby the coal getters only work 6¼ hours "at face." The production has fallen off in inverse ratio to the considerable increase in wages. The Government intends to introduce a Bill modifying the eight hours' day in so far as it affects the collieries, and the men's union is already threatening a strike, although, as it does not appear to be well provided with funds, it is probable that the union will hesitate before carrying it into effect. In some of the engineering trades there is the same agitation, and it is evident that the labour question is reaching a stage when the errors of politicians in giving indiscriminate advantages to the workers and tying the hands of employers may bring about a struggle from which the country will suffer for a long while to come.

Railway Catastrophe.

The railway accident on the Midi line last week, when one train ran back into another, both carrying pilgrims to Lourdes, was remarkable for the peculiar circumstances under which it occurred. One train was timed to pass Miélan, near Tarbes, half an hour after the other. At the previous stoppage at Agen the driver of the first train reported that his compressed air brakes were not working satisfactorily, and it has also been stated that there was some difficulty in taking the gradients, but the official report affirms that the locomotive, which is of modern construction, was in excellent condition, and that a pressure of 170 lb. was maintained, except when the driver had to replace a split pin in the spindle of the injector lever during which time an excess of water was injected into the boiler. This had the effect of priming the compressed air pump, which was already working badly. On arriving at the gradient beyond Miélan the locomotive had some difficulty in going up on account of a drizzling rain making the rails greasy. The compressed air sand distributor could not work because the pump was giving less than half the pressure required. The brakesman in the rear van ran back to cover the following train. Meanwhile, the first train continued to advance slowly up the incline until to within about 500 yards of the top, when it came to a standstill. In trying to get under weigh again the eight-coupled driving wheels slipped more and more on the greasy rails, and the train began to move backwards. In the official statement the brakesman in the first van is said to have made the mistake of jamming down the hand brake instead of trying to retard the train by putting it on and off repeatedly, and the driver is blamed for putting the lever in the top forward-speed notch. Meanwhile, the driver of the second train, in view of the short distance, decided that the best way to minimise the disaster was to brake his train and await the impact before the momentum became too great. The shock smashed the rear van and two coaches of the first train into splinters, but the locomotive, which withstood the shock, was practically undamaged.

The State Railways.

The various Chambers of Commerce in Brittany are agitating strongly against the proposed handing over of the State Railways to a company constituted under such conditions that it would be necessarily more or less under political influences. As the Government refuses to split up the system and incorporate a part into the Nord and a part into the Paris-Orleans, it is proposed to allow these two companies to form a separate company for the working of the State railways. Should this proposal be rejected, it is suggested, as an alternative, that the new company should be formed with a board of directors and a general management selected in such a way as to ensure their entire independence of the State and of politicians.

Steam Plant Orders.

While the situation of the engineering trades is generally unsatisfactory, the laying down of powerful electrical generating plants is nevertheless providing some valuable contracts, and one firm in the Nord, which has been very short of work for many months, has secured an order for steam-raising plant, including generators of the Stirling type, having a heating surface of 22,604 square feet. The value of the order is 10 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

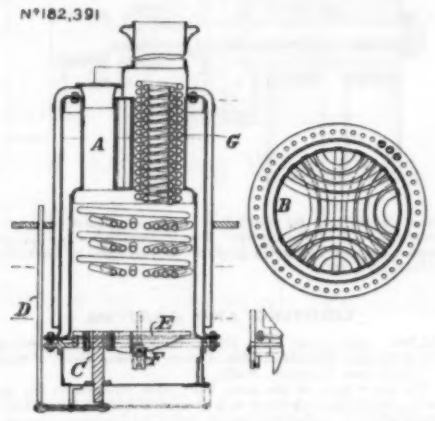
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

182,391. November 11th, 1921.—Vertical Boilers, R. L. K. Hazel, 23, Lexden-street, Lexden, Essex, and Davey, Paxman and Co., Limited, Colchester.

In this boiler the hopper A, through which the fuel is introduced, passes through the steam and water spaces, so that it is kept cool, and terminates over the opening B left between the water tubes for the fuel to fall down through on to the

N°182,391



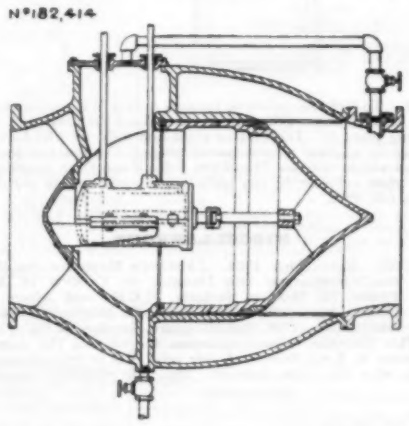
grate. Directly below this a plunger C is arranged in the grate and can be operated by the push rod D to break up clinkers, &c. One-half of the grate, marked E, can be pivoted about F to dump the clinkers into the ashpan. One of the flue tubes is considerably enlarged, and used to accommodate the superheating coil G.—*July 6th*, 1922.

TURBINE MACHINERY.

182,414. February 24th, 1921.—Hydraulic Valves, *A. E. White*, 88-90, *Chancery-lane, London, W.C.* 2.

This invention relates to valves of the plunger type in which an inner chamber is supported centrally of an outer casing, so as to provide an annular water passage therebetween, the inner chamber comprising a fixed portion and a movable plunger adapted to close and open the annular water passage-way. The valve is operated in different ways, sometimes by fluid pressure and in other constructions it is operated mechanically by gear leading from the valve to the exterior of the outer casing through a suitable passage-way. According to the present invention an inspection or access well extends from the outer casing across the water passage-way to the fixed portion of the inner chamber. For relatively small valves this well will be large enough to permit any operating parts within the inner chamber to be loosened or removed from the interior by reaching

N°182,414



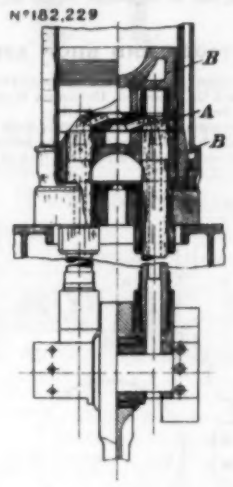
down into the inner chamber from the outer casing, and in relatively large valves, the well will be sufficiently large to permit a workman to enter the inner chamber and to make the necessary repairs or replacements in the same. The provision of means for draining the inner chamber render it possible to make the repairs or replacements, not only without draining the pipe line, but even with the valve full open and the water passing through the pipe line and through the water passage-way which surrounds the inner valve chamber. Means are further provided for preventing the leakage of water or any considerable amount of water, into the inner chamber through the clearance between the stationary and movable parts of the valve when the valve is in its full open position. The construction, shown in the drawing, is obvious.—*June 26th*, 1922.

INTERNAL COMBUSTION ENGINES.

182,229. April 6th, 1921.—Double-acting Engines, B. W. Knott, A. W. Newman and H. Penwardine, Admiralty Engineering Laboratory, West Drayton, Middlesex.

The object of this invention is to provide a combustion space in the cylinder, at the end next to the crank shaft, which is not obstructed by the piston-rod. A hemispherical cavity is thus formed in the piston, as shown, and two or more piston-rods are used, but are so disposed that they are clear of the combustion space. The piston is built up of a central member A, to which the piston-rods are secured, and two separate castings B B, with the hemispherical cavities referred to. A circulation

N°182,229

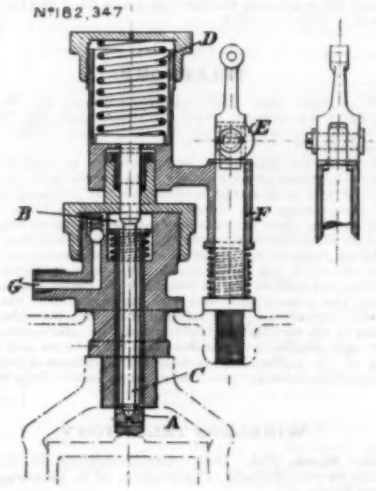


of cooling water is provided up one hollow piston-rod and down the other.—*July 6th*, 1922.

182,347. August 8th, 1921.—Fuel Injection, L. Bailly, 119, West First-avenue, Columbus, Ohio.

This fuel injector, for two-stroke engines, acts through the piston of the engine striking the plunger A at the end of its stroke, with the result that the fuel in B is put under pressure, forced down the hollow plunger, and injected into the combustion chamber of the cylinder. The needle valve C is then pressed

N°182,347



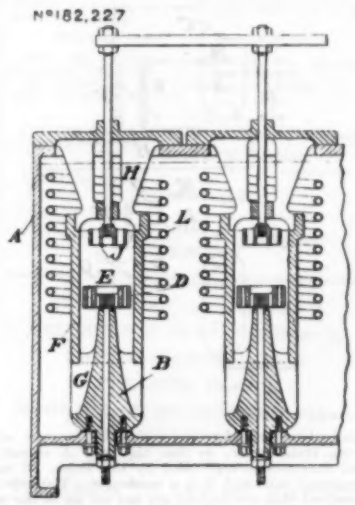
down on to its seating in the plunger by the spring D, and remains so during the explosion. The casing of the spring D can be adjusted as regards height, by means of the cam E and slide F, so that the amount of fuel injected may be regulated. The fuel inlet is shown at G.—*July 6th*, 1922.

SWITCHGEAR.

182,227. April 5th, 1921.—An Improved Electric Controller, Robert Frederick Baerlocher, of 4, Arlington-road, West Ealing.

The containing vessel of the controller is shown at A. To the base of this container supports B of insulating material are secured, these supports carrying at their upper ends fixed electrodes D, preferably perforated as shown at E. The electrodes D are disposed within tubular chambers F, which are of

N°182,227



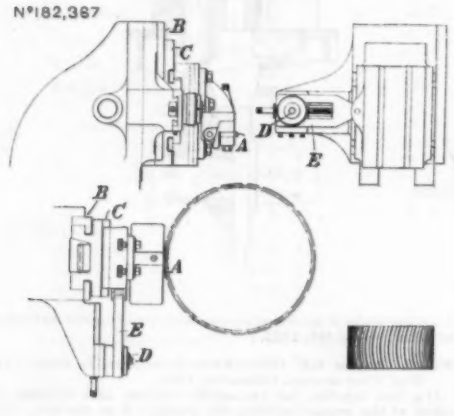
earthenware, these chambers being open at both ends and maintained in position by engagement of their lower ends with fins G extending laterally from the supports B. Guides are provided at H for the rods attached to the movable electrodes J. With the construction above described the electrolyte which fills the

containing vessel has free access around and through the electrodes D and J, the latter being moved vertically upwards or downwards to achieve the desired resistance. The chambers F may be surrounded by a coil or coils of piping L, through which a cooling medium may be circulated.—*July 5th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

182,367. September 6th, 1921.—Gear-cutting Machines, Wm. Muir and Co., Limited, Britannia Works, Sherbourne-street, Manchester, and J. H. Melloy.

This machine is intended for cutting involute gear teeth with a curved form as shown. The teeth are generated by a rack cutter A, which is reciprocated across the face of the blank along



the slide B. Provision for movement at right angles to B is made by the slide C, while the tool box is anchored to the pivot D by the link E, with the result that the desired curvilinear movement is given to the cutter. The blank is given the motions necessary for generating the involute tooth form and for spacing the teeth.—*July 6th*, 1922.

TELEPHONY.

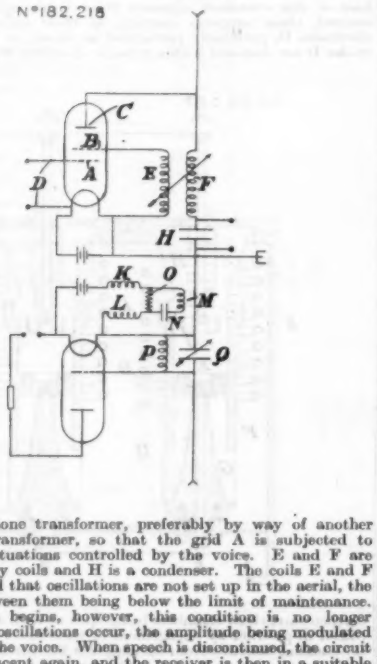
161,521. April 6th, 1921.—Improvements in High-frequency Telephone Systems, Gesellschaft für Drahtlose Telegraphie, m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

This invention relates to improvements in high-frequency telephone systems and its object is to give a limit to the frequency of the modulating oscillations. It is found that the higher frequencies, say, above 7500, though audible, are prejudicial in that they prevent several conversations from being carried on simultaneously over the same line, but that if such modulating frequencies are prevented from passing to the line greater efficiency can be obtained. One or more pupin coils—i.e., iron-cored coils as free as possible from losses—are arranged between the microphone and the high-frequency thermionic generator controlled by the microphone. Besides reducing the damping of the oscillations transmitted, the interposition of the coil or coils results in a purification of the tones and the frequency of the oscillations reaching the telephone is kept down in a manner suitable for practical requirements.—*July 6th*, 1922.

WIRELESS TELEPHONY.

182,218. March 31st, 1921.—Improvements in Wireless Telephony, Richard Whiddington, of 9, Bainbrigge-road, Headingley.

One of the disadvantages attending the use of wireless telephony, the inventor states, is that both-way conversation cannot be achieved in a manner similar to that carried on over an ordinary telephone line. This arises from the fact that during the intervals between speech the aerial is continuously radiating energy, which renders the receiving valve inoperative. The difficulty has been overcome by operating switches, which cut off the transmitting power whenever it is desired to listen, and to switch on again when it is desired to speak. The object of this invention is to provide an alternative automatic method for achieving this. The transmitter consists of a four-electrode valve, composed of a hot filament, two insulated grids A and B, and an anode C. The terminals D are connected to the secondary

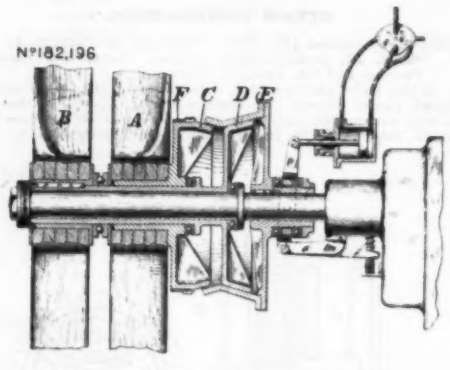


of a microphone transformer, preferably by way of another amplifying transformer, so that the grid A is subjected to potential fluctuations controlled by the voice. E and F are high-frequency coils and H is a condenser. The coils E and F are so coupled that oscillations are not set up in the aerial, the coupling between them being below the limit of maintenance. When speech begins, however, this condition is no longer realised, and oscillations occur, the amplitude being modulated according to the voice. When speech is discontinued, the circuit becomes quiescent again, and the receiver is then in a suitable state for reception. The receiving circuit is shown below the transmitting circuit, and it is more or less self-explanatory. In the filament circuit of the valve there are inductances K L M, a condenser N and a resistance O. There is also an inductance at P, and a variable condenser at Q.—*June 30th*, 1922.

AERONAUTICS.

182,196. March 24th, 1921.—An Aeronautic Brake, D. McNab Ramsay, 156, Stanmore-road, Mount Florida, Glasgow.

The inventor proposes to use a screw propeller A, of opposite pitch to the normal propeller B, for checking the speed of an aeroplane on alighting. Both propellers are mounted on sleeves which are furnished with clutch members C and D. Either of

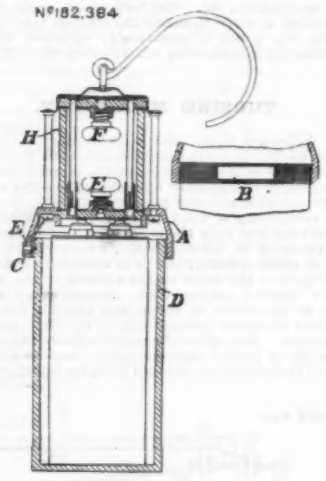


these sleeves can be connected with the engine through the female part E of the clutch. The inoperative screw propeller rotates freely on ball bearings or can be restrained by the brake F.—*June 26th*, 1922.

LIGHTING AND HEATING.

182,364. September 5th, 1921.—Improvements in Miners' Electric Safety Lamps, Arthur Poynton Ford, of Sutherland-road, Longton, Staffs.

The lower part of the lamp body D is screwed to the upper part. In the part A there is a groove B for the reception of a spring plate C, the recess having sufficient length to permit the part D to turn and thereby allow the battery terminals to be brought into contact with the contact discs below the bottom

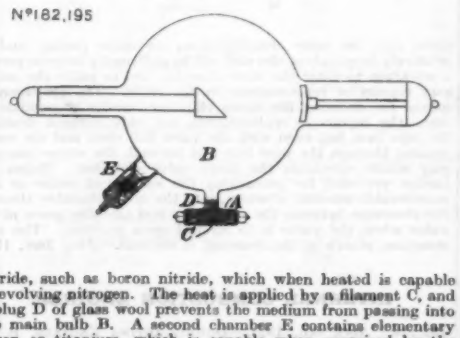


bulb. To lock the switch so formed, a rivet E is passed through the wall of the part A and pressed against the lower end of the spring plate C. The bolt or rivet can only be withdrawn by using an electro or permanent magnet. An accumulator is fitted within the case D and two bulbs E and F are fitted within the glass cylinder H, the bulbs being connected in parallel.—*July 6th*, 1922.

MISCELLANEOUS.

182,195. March 24th, 1921.—Improved Methods and Means for Regulating the Degree of Vacuum in X-ray Tubes, Sir Herbert Jackson, K.C.B., and Albert John Philpot, both of the British Scientific Instrument Research Association, of 26, Russell-square, London, W.C.

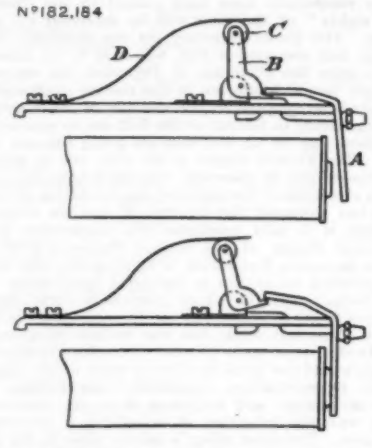
This invention relates to means for varying the degree of vacuum in X-ray tubes. A side tube A is in free communication with the main tube B. This side chamber contains a



nitride, such as boron nitride, which when heated is capable of evolving nitrogen. The heat is applied by a filament C, and a plug D of glass wool prevents the medium from passing into the main bulb B. A second chamber E contains elementary boron or titanium, which is capable when energised by the passage of a current of absorbing nitrogen.—*June 26th*, 1922.

182,184. March 24th, 1921.—Improvements in Electro-magnets, The Relay Automatic Telephone Company, Limited, and William Douglas Edwards, of Marconi House, Strand.

This invention relates to electro-magnetic relays. The relay armature A has a projection which is engaged by one arm of a latch B, which carries an anti-friction wheel C. Upon this wheel a spring D presses. The latch is adjusted so that when the armature is in the normal, or unoperated position, the centre of the wheel lies slightly to the rear of the latch pivot. The spring is adjusted so that when the armature is in the operated position the pressure of the spring is almost sufficient to maintain the armature in that position against the circuit closing springs—not shown—which tend to restore the armature to its normal position. When the armature is in its normal position, owing to the very small leverage of the wheel, the spring D is unable to overcome the pressure exerted by the circuit closing



springs, which keep the armature in its normal position. Upon energising the relay, the armature A becomes attracted, removing the counter-balancing tension of the circuit-closing springs, so that the spring D can move the latch into its operated position. In this position the energising or holding current can be reduced just sufficiently to supply the deficiency of the pressure of the spring D. When the energising or holding current is removed, the balance of tension is restored to the circuit-closing springs, which are able to restore the armature and latch to normal. It will be seen that by the use of this device, it is possible considerably to reduce the current required to hold the relay in its operated position.—*June 26th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TUESDAY TO FRIDAY, SEPTEMBER 5TH TO 8TH.

Iron and Steel Institute.—Autumn meeting at York. For programme see page 96.

WEDNESDAY TO FRIDAY, SEPTEMBER 20TH TO 22ND.

The Institute of Metals.—Swansea. Annual autumn meeting. For Programme see page 152.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Parker, Winder and Achurch, Limited, of Birmingham, are now opening offices and showrooms in London at 40, Craven-street, Strand, W.C. 2.

We are asked to state that Mr. Richard Allthorpe, for many years manager of the wire netting department of Boulton and Paul, Limited, Norwich, has been obliged, through serious ill-health, to resign his position. His successor as head of the department is Mr. Walter Murray.

Mr. John J. Ash informs us that he has severed his connection with the British Thomson-Houston Company, in the Industrial Control Department, of which he was employed for many years. He has now entered into partnership with Mr. R. J. D'Arcy Hart, A.M. Inst. C.E., at 70, Victoria-street, London, S.W., where they are carrying on business as engineers under the name of Ash and Hart.

Contracts.—August's Muffle Furnaces, Limited, of Halifax, informs us that it has recently received three repeat orders and five new orders for its standard patent muffle furnaces for heat treatment, normalising, annealing and case-hardening, and also an order for a battery of eight of its various types of core and mould drying ovens.

Archibald Dawnay Scholarships, 1922.—In accordance with the terms of the will of the late Sir Archibald Dawnay, the Royal Institute of British Architects has awarded, for the first time, two scholarships, each of £50 per annum for two years, to Mr. E. U. Channon, Architectural Association, and Mr. D. J. A. Ross, Robert Gordon's Technical College, Aberdeen; and one scholarship of £25 per annum for two years to Mr. C. S. White, Architectural Association. The scholarships are intended to foster the advanced study of construction and the improvement generally of constructional methods and materials and their influence on design.

Engineering Joint Council.—It is announced that proposals for closer co-operation amongst the leading engineering institutions, which have recently been under consideration, have now received the approval of the Institutions, the representatives of which met in conference, namely, the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Institution of Electrical Engineers, and that an Engineering Joint Council composed of representatives of those bodies has been formed. Among the objects of the Joint Council will be to improve the status of engineers, to secure the better utilisation of their services in the country's interests, and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. It is anticipated that, at a later stage, the number of bodies represented on the Joint Council may be increased, but that at present remains a matter for future consideration for the Joint Council and the Institutions concerned.